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IRRIGATION FROM INTERSTATE RIVERS.

The Arkansas is a typical river of the Rocky Mountains and the Great Plains. It rises in Tennessee Pass, Colorado, 10400 feet above the sea, emerges from the mountains at Canon City, flows eastward through Colorado for 570 miles, and then across Kansas, Oklahoma and Arkansas to the Mississippi River, a total distance of 1497 miles.

From Canon City, Colorado, to the Kansas state line, the length of the Arkansas is about 448 miles, and along this stretch of the river Colorado had authorized the diversion of more water than the stream discharges at the mouth of the Royal Gorge. Prior to 1885 comparatively little water was diverted from the Arkansas River in Colorado for irrigation, but from about that date down to 1890 canals and ditches with a combined capacity of 3,636 cubic feet of water per second were constructed by corporations under authority from Colorado to divert water from the river.

For the years 1890, 1895 and 1900 the discharge of the Arkansas River at Canon City ranged from 310 to 345 cubic feet of mean discharge in January, rose to a mean of 1,900 to 3,492 cubic feet in June, and then fell to a mean of 298 to 502 cubic feet in December, thus showing the marked effect of the melting snows in Summer. Besides this discharge of the main river the Arkansas has about twenty-five tributaries in Colorado, and its drainage area there is 26,000 square miles, but the discharge of the tributaries is not known.

Under the above circumstances the State of Kansas filed a bill in equity against the State of Colorado and its corporations alleging that the diversion of a great part of the flow of the Arkansas River in Colorado was working great injury to Kansas and its citizens, and was in violation of the right of riparian owners along the river to have its flow continue in the natural way through the latter state.

Counsel for the United States also filed a petition in the case, claiming the right to control the diversion of the water of the Arkansas River under acts of Congress for the reclamation of arid lands.

In the language of the Supreme Court, the following questions were involved in the case:

"Turning now to the controversy as here presented, it is whether Kansas has a right to the continuous flow of the waters of the Arkansas River, as that flow existed before any human interference therewith, or Colorado the right to appropriate the water of that stream so as to prevent that con-

tinuous flow, or that the amount of the flow is subject to the superior authority and supervisory control of the United States."

Passing to a consideration of the power of each State to make laws relative to flowing water, the Court said:

"It may determine for itself whether the common law rule in respect to riparian rights or that doctrine which obtains in the arid regions of the West of the appropriation of waters for the purposes of irrigation shall control. Congress cannot enforce either rule upon any State."

But in this case the question was whether one state by authorizing the diversion of water for irrigation can prevent its flow into another state, and whether the United States Supreme Court has power to decide a controversy between states under such circumstances. On these points the opinion ran thus:

"Colorado by its legislation has recognized the right of appropriating the flowing waters to the purposes of irrigation. Now the question arises between two States, one recognizing generally the common law rule of riparian rights and the other prescribing the doctrine of the public ownership of flowing water. Neither State can legislate for or impose its own policy upon the other. A stream flows through the two and a controversy is presented as to the flow of that stream. It does not follow, however, that because Congress cannot determine the rule which shall control between the two States or because neither State can enforce its own policy upon the other, that the controversy ceases to be of a justifiable nature, or that there is no power which can take cognizance of the controversy and determine the relative rights of the two States. Indeed, the disagreement, coupled with its effect upon a stream passing through the two States, makes a matter for investigation and determination by this court."

It was pointed out by the court that the reclamation of the arid lands in Colorado was possible only by the diversion of the waters of the Arkansas River, but that the diversion of all the water in Colorado would reduce the productiveness of the lands in Kansas. On the other hand, if the extreme rule of the common law that the water of the river must be left to flow in the natural way was applied, a large portion of the land in Colorado must remain a desert. More than this, if Kansas could enforce a claim that Colorado should divert none of the water of the Arkansas River, then Oklahoma could enforce the same rule against Kansas, and the water of the river would finally flow into the Mississippi without having done any of the necessary work of irrigation.

It appeared from a large amount of evidence and the court concluded that the diversion of the water in Colorado had resulted in a great increase of population and of the value of farm products there along the valley of the Arkansas River. It also appeared that the counties in Kansas along the river and near to Colorado had lost in both population and amount of agricultural products since 1890, the date when the irrigation system in Colorado reached an advanced state. As to the general affect of the diversion of the water of the Arkansas in Colorado, the court understood the evidence given below, as follows:

"It cannot be denied in view of all the testimony * * * that the diminution of the flow of water in the river by the irrigation of Colorado has worked some detriment to the southwestern part of Kansas, and yet when we compare the amount of this detriment with the great benefit which has obviously resulted to the counties in Colorado, it would seem that equality of right and equity between the two States forbids any interference with the present withdrawal of water in Colorado for purposes of irrigation. * * *

"At the same time it is obvious that if the depletion of the waters of the river by Colorado continues to increase there will come a time when Kansas may justly say that there is no longer an equitable division of benefits and may rightfully call for relief against the action of Colorado, its corporations and citizens in appropriating the waters of the Arkansas for irrigation purposes."

This decision is certainly one to hearten investors for the development of irrigation and hydroelectric projects, many of which are being projected at the present time.

THE UBIQUITOUS ELECTRIC MOTOR.

Before the advent of the electric motor, a breakdown of the main engine of a mill or factory was usually a matter of serious consequence, often causing a complete tie-up of the whole works for several months until the necessary repairs could be made. It is pleasing, therefore, to be able to record a case in which a stoppage of probably from five to six months for repairs to a mill engine was cut down to a little over a week by the substitution of electric drive for the mechanical drive previously used.

The instance in question is reported from England. It appears that the main driving engine of the mills of Marshall, Kaye & Marshall at Ravensthorpe, in the county of Yorkshire, recently suffered a serious breakdown, and the directors of the company were quick to appreciate the facility with which electric motors could be installed for driving their machinery. Accordingly, the transformation to electric drive was commenced immediately after the accident with the result that the machinery in practically all of the various departments was able to be restarted in less than ten days after the breakdown. Electric power for the motors is taken from the mains of the Yorkshire Electric Power Company, the total amount needed being in the neighborhood of 400 horsepower.

The quickness with which the change-over was effected was quite a feat in engineering, and reflects great credit on all the parties concerned. Thus was another convert obtained to electric drive, and it does not seem likely that the new order of things will now be changed in this particular case. The moral is obvious, and much notice will be paid it by owners of steam-driven plants.

ELECTROPLATING WITHOUT ELECTRICITY.

At a recent meeting of the Royal Society of Arts, in London, England, Mr. A. Rosenberg described a new process of electroplating which is of interest by reason of the fact that no external source of electricity is required in its operation. The plating metal is mixed in the form of a metallic salt or a powder with the sulphate or some other salt of ammonium, and with a finely powdered electropositive metal, generally magnesium. The metal to be plated is merely cleaned and rubbed with the plating powder which is previously moistened with water. A bright deposit is obtainable in about a minute, and the thickness of the deposit depends on the time of rubbing and the amount of powder used. It is claimed that an article which has previously been plated can be replated after it has been in use, without stripping the old deposit as is usually necessary with the ordinary method of electroplating. Of course the action of the process is electrical, the electropositive reaction of the magnesium (acting as an anode) causing the plating metal (which may be tin, silver, nickel, etc.) to go into solution and become deposited. For small articles of simple shape it seems probable that the new process will prove of some value, although in cases where an absolutely even deposit of some thickness is required, and for electroplating articles of intricate shape or of considerable size, the usual method of electroplating will undoubtedly prove superior.

THE POPULARITY AND ECONOMY OF THE ELECTRIC AUTOMOBILE.

While the gasoline car is at present pre-eminent for long-distance running and hill climbing, the electric automobile is without a doubt unsurpassed for ordinary everyday use.

Some interesting information on the popularity and economies of the electric automobile was given in a recent newspaper article by Mr. John T. Fisher, the manager of the Chicago branch of the Babcock Electric Carriage Company. Mr. Fisher, while standing on a prominent corner of one of the South Side boulevards in Chicago a few days ago, counted the automobiles passing each way for half an hour. These numbered 307, of which 144, or nearly forty-seven per cent, were electric vehicles, driven mostly by ladies. It is safe to say, in view of the growing popularity of the "electric," due in no small measure to the interest the central-station men are taking in this type of vehicle, that this already large percentage will be materially increased in the near future, and that within the next year or so the great majority of automobiles used within the limits of any sizable city will be electrically propelled.

Mr. Fisher stated that any first-class garage will charge the batteries of an electric automobile, wash and polish the vehicle, and deliver and call for it, whenever the owner may desire, at a cost of from $30 to $35 a month, which charge also includes the care of the batteries. When the owner of an electric car cares for his own machine and charges the batteries himself, Mr. Fisher estimates the cost at from $4.00 to $6.00 a month, which is much less than the upkeep of a horse-drawn vehicle.

In Mr. Fisher's experience in the automobile business, he has found that for the months from July to December, inclusive, taking ten different makes of machine, the average mileage worked out to twenty-eight miles a day. This figure is well within the single-charge capacity of any make of electric car, so that it is immediately apparent that the electric automobile will fill the requirements of most people on most occasions.

For the lady shopping down town or driving out on the boulevards or in the parks, for theater going or for social calling, for the practicing physician making his calls, and for any similar purposes, the electric automobile is unrivaled. Its moderate first cost, its small upkeep expenses, its noiselessness, cleanliness, reliability, and lack of obectionable odors, and its remarkable ease of control and operation make it unequaled for city purposes, and the central-station man who does not make a special point of catering to the needs of the electric vehicle operator will lose a large and profitable business which would add materially to his day load and thereby considerably improve his station-load-factor.

AN INSTANCE OF LOSS IN MUNICIPAL LIGHTING.

Among the rumors of losses and gains by municipal plants, comes an authentic report of the finances of a $300,000 municipal power plant which has been in operation in the state of Indiana for a period of about one year and three months.

The investigation of this Indiana plant which was carried out, not by the city, but by a competing company, shows that the plant had operated since its installation, at a total loss of $29,000. This represents an annual loss of about nine per cent per annum on the city's investment.

A greater part of the loss is attributed to commercial lighting, which service is supplied at a rate of 6.1 cents per kilowatt hour, although it was demonstrated by the investigators that under present conditions this power was generated at a cost of eight cents.

This state of affairs shows that in some instances, at least, the cities overstep in their efforts to supply lighting at a low rate. Only the expenses directly in view of the officials are taken into consideration and those unforeseen at the time of fixing the low rates must be met at a loss, which is paid by all of the taxpayers.

It is rather interesting to note that even after the investigation had been conducted, the city officials declared the plant an unqualified success, because it had succeeded in reducing the price of commercial lighting from ten cents to six cents per kilowatt hour.

Commission News from New York.

The New York Public Service Commission, Second District, has authorized the Cliff Electrical Distributing Company of Niagara Falls to issue $400,000 five per cent thirty-year bonds to be sold at not less than ninety-five. The proceeds are to be used for additions ordered or immediately needed for generating station, $96,443; additions ordered and in process of construction or immediately necessary for distributing plant, $126,192.35; additions needed by September 1, 1910, $147,660; organization and mortgage issue expenses, $8,701.33.

The commission has also authorized the Niagara Light, Heat and Power Company, of Tonawanda, to issue $21,000 of an issue of $500,000 of its bonds, bonds to be sold at not less than eighty-five, the proceeds to be used for the payment of outstanding obligations and additions and betterments of its plant.

The commission has given its approval to the Westchester Electric Railroad Company to exercise franchises granted by the Board of Alderman of the city of Mount Vernon on September 27, 1909, and by the Board of Trustees of the village of Pelham Manor on November 8, 1909. The commission grants these approvals upon the express conditions that the receiver of the Westchester Electric Railroad Company and any and all persons and corporations who shall hereafter claim or exercise any rights under these franchises shall by the acceptance of the order assent to the understanding that these permissions and approvals are not at any time or under any circumstances to be treated or considered as limiting or modifying any powers conferred by law upon the Public Service Commission.

In its order the Commission states that the franchises in question contain several provisions which may be construed as limiting the powers of the Commission as conferred by the Public Service Commissions Law over the fares to be charged by this company in its operation under the franchises and other provisions may be construed as limiting other powers of the Commission. It is further stated that the commission understands that it has the right and that it is its duty to refuse permission and approval to exercise any franchise which may be construed to limit the powers conferred upon it by law either directly or by necessary implication, and it further understands that it should not approve the franchises if they may be construed as limiting its power to require in a proper case the person or corporation operating under the franchises to charge a fare of less than ten cents through fare and less than five cents locally as provided in the franchises.

Objects to Public Service Commission.

Hon. Joseph Choate, former ambassador to Great Britain, severely arraigned the Public Service Commission of New York State recently at a hearing before the Assembly committee on railroads. Mr. Choate appeared in opposition to the bill introduced by Assemblyman Parker, which seeks to extend the jurisdiction of the Public Service Commission so that it will have a greater power over railroads, gas and electrical corporations. Mr. Choate represented the receivers of Metropolitan and Third Avenue street railway companies of New York city. In speaking of the Public Service Commission, First District, he declared that it had issued orders which were impossible of fulfillment. Mr. Choate further declared that the things now advocated by the Commission were beyond all reason, especially its plea for universal transfers. He pointed out that the universal transfer system had dealt the final blow to the Metropolitan railway system.

Forty-Second Street, St. Nicholas Line.

The sale under foreclosure of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company property, franchises and securities, which was set for March 23, has been postponed by an order of Judge Lacombe in the United States Circuit Court until May 16. The order was granted on motion of the Union Trust Company, which holds a mortgage of $1,600,000 which it seeks to foreclose, and is agreed to by the Forty-second street line. Frederick W. Whitridge, receiver for the railway company, and the Barber Asphalt Paving Company, defendants in the action, also agreed to the postponement. Mr. Morton said that bonds of $1,460,000 secured by the mortgage were sold under the decree of foreclosure of the Third Avenue Railroad Company, and because of the plan of reorganization of that company now under consideration by the Public Service Commission further time is required for settlement, and the interests of the present bondholders will be better served by the adjournment of the sale.

Waterpower Situation in New York.

A preliminary hearing on the proposed amendment to the New York state constitution, offered by Assemblyman Edwin A. Merritt, Jr., providing that the forestry protective article be widened to let in water storage, was held recently before the Assembly committee on judiciary. Those in favor of the amendment have already offered arguments and a further hearing will be held on March 29 for the opposition.

The main argument presented was that water storage and development of power were needs of the state which should not be blocked or retarded by sentiment.

Assemblyman Merritt, Virgil K. Kellogg, of Watertown; former State Senator Elon R. Brown, of Watertown; Judge Moore, of New York city; E. N. Smith, of Watertown, and F. B. De Berard, representing the Merchants' Association of New York, all spoke in favor of the proposed amendment.

Mr. De Berard said that industrial development would result if the amendment was enacted into law. He contrasted the situation in New England with that which existed in the state of New York, stating that in New England the waters were impounded and industries existed all along the streams. In New York state, he said, the bulk of the water went to waste in floods. He said, further, that he favored a change in the amendment to the end that the waters be allowed to be used for municipal purposes.

Mica Duty Lowered.

As the result of an objection made as to the tariff assessment made on a consignment of mica by the collector of customs at Plattsburg, N. Y., the duty on rough trimmed mica has been considerably lowered. The original tariff assessed against this mica was ten cents per pound and twenty per cent ad valorem.

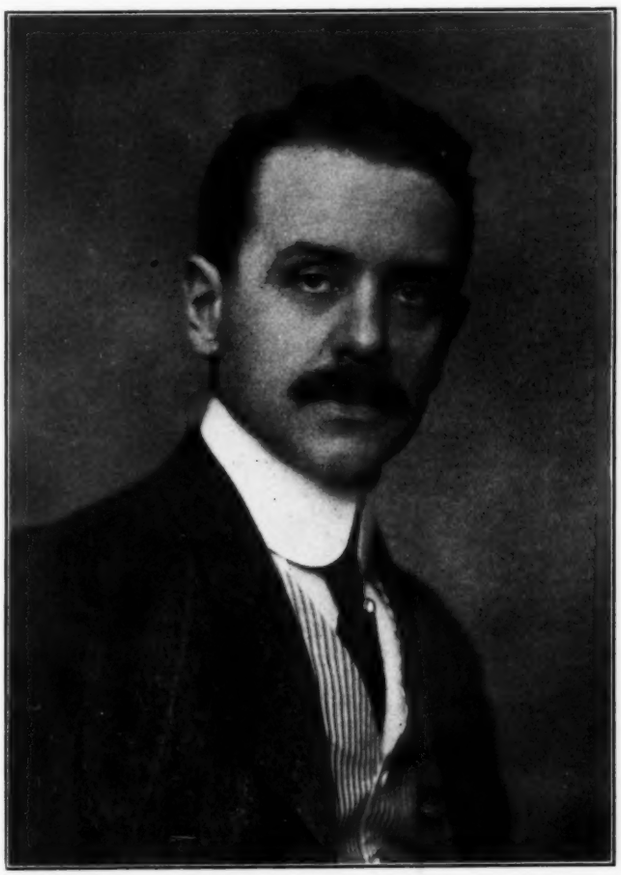
The objection, which was sustained by the Board of United States General Appraisers, was made on the ground that the sheets were in no manner trimmed for use, but only with a view of eliminating the worthless parts.

Lewis B. Stillwell.

Lewis Buckley Stillwell, president of the American Institute of Electrical Engineers, is one of the few men who have achieved so remarkable an engineering success within a comparatively short time after aspiring to that degree which entitled him to recognition among the peers of his profession.

As an engineer, Mr. Stillwell ranks conspicuously as a successful man. He has been identified since early in the nineties with the scientific and practical working out of some of the most important of the world's engineering problems. He was foremost in the harnessing of Niagara power and in the generation and transmission of electric currents in large volume and in the application of this energy to industrial working. Mr. Stillwell was also prominently connected with the electrification of New York City's elevated railway system, with the electrical equipment of the New York rapid transit subway, and with the preparations and plans for the mammoth power house and electrification of the Pennsylvania Railway's terminals and subways in New Jersey and under the Hudson River.

Mr. Stillwell was born in Scranton, Pa., March 12, 1863. Although by birth a Pennsylvanian, he is a descendant of an old New York family, prominent in Colonial history. He was graduated at the Scranton High School, matriculated at Wesleyan University, and after two years' work there took up the study of electrical engineering at Lehigh, where he completed the electrical course in 1885, taking a post-graduate course at Lehigh in mechanical engineering during 1885 and 1886. In October, 1886, he became assistant electrician of the Westinghouse Electric and Manufacturing Company at Pittsburg, where he was associated with Shallenberger, Stanley and Tesla, particularly in the commercial development of the alternating current system of lighting and power distribution.



LEWIS BUCKLEY STILLWELL,
President of the American Institute of Electrical Engineers.

In April, 1890, he was promoted to chief electrical engineer and in 1895 added to his title that of assistant manager. He resigned in March, 1897, to become electrical director of the Cataract Construction Company and Niagara Falls Power Company at Niagar Falls, N. Y., having while with the Westinghouse company directed the preparation of the plans for the electrical utilization of Niagara which were finally adopted by the Cataract Construction Company. While at Niagara he acted as consulting engineer for various other enterprises, and in March, 1899, he acepted the position of consulting electrical engineer to the Manhattan Railway Company of New York City.

Upon the completion of the first power plant at Niagara in September, 1900, he resigned his positions with the Niagara companies to give his entire time to the railway company, and to practice as consulting engineer in New York City. In November, 1900, he became electrical director of the Rapid Transit Subway Construction Company. Mr. Stillwell is an inventor of ability and has been a liberal contributor to the technical and scientific press. He was elected president of the American Institute of Electrical Enginers in July 1909, and is also a member of the American Philosophical Society, the American Society of Mechanical Engineers, the British Institute of Electrical Engineers, and many other electrical and scientific organizations.

New Subway Service in New York City.

The new subway schedule which went into effect on the Interborough Rapid Transit Company's lines a short time ago met with marked success. Frank Healy, general manager of the company, in speaking of the new service, said:

"For the first time the complete schedule of one minute and forty-eight seconds was put into effect for both express and local service, and under such a headway we had to operate 1,904 trains, compared with 1,776 previously. Passing Ninety-sixth street up to nine o'clock the latest express train was one and one-half minutes late, for a period of two hours. In other words, we lost but one train in that time.

"At ten o'clock the Lenox avenue express service at Ninety-sixth street was four minutes late. The Broadway express service lost five minutes, or practically three trains in three hours. All local trains were on time at ten o'clock passing Ninety-sixth street, but were five minutes late on arriving at the Brooklyn bridge station of the Interborough line.

"It must be remembered that this headway had to be maintained for a period of five hours and two minutes, allowing for both southbound and northbound trips, and on to-day's showing it is safe to say that the operation of the subway is practically perfect, and I cannot see where any complaint can be made."

Brooklyn Edison Sales Department Holds Annual Dinner.

The Sales Department of the Edison Electric Illuminating Company of Brooklyn enjoyed its annual dinner on Saturday evening, March 19, at the Hof Brau Haus, Booklyn. About fifty guests sat down and discussed an elaborate and very satisfactory menu. T. I. Jones, general sales agent, acted as toastmaster and the following officers of the company were the guests of the department: W. W. Freeman (vice-president), W. F. Wells (general superintendent), P. R. Atkinson (treasurer), J. H. Evans (secretary), and R. D. Rubright (auditor). Interesting addesses were delivered by all of these gentlemen.

The keynote of the evening, and of most of the talks, was co-operation. Mr. Jones thanked the members of his department, giving them credit for the satisfactory results obtained during the past six months. Mr. Freeman spoke on "The Salesman and the Public." He dwelt on the difference between the nature of service offered by an electric light and power company and other types of public service enterprises.

After the speeches, a vaudeville program was presented. The committee in charge of the dinner consisted of P. H. Kemble, C. H. Thurling and H. G. Disque.

Chicago Electric Club.

A very entertaining and profitable session was held by the Chicago Electric Club on Wednesday, March 16. The meeting was designated as a "Glad Hand" session, and as chairman of the reception committee, Frank L. Perry described a plan by which it was expected that a more informal social atmosphere of the club might be introduced into the club life.

Mr. Perry's plan was to have each attendant at the meeting attach to the lapel of his coat an ordinary business card upon the reverse side of which was marked in large letters his name and business connection. It has been found again and again that men will naturally shy off from each other if they have once been introduced but have forgotten each other's names. In this way an aloofness, which has proven unfortunate, has often been occasioned, and it is desired to make this impossible in the life of the Chicago Electric Club.

A number of members warmly endorsed Mr. Perry's idea, and it will be tried out now for some time with, it is believed, the most satisfactory results.

The Illuminating Engineering Society.

The Illuminating Engineering Society held its regular monthly meeting, on March 17 last, at the Engineering Societies Building, New York city. The following papers were presented and discussed: "The Relationship of Decoration to the Illuminating Engineering Practice," by C. R. Clifford (read by A. J. Marshall in the author's absence); "Luminous Efficiency," by H. E. Ives; "A Standard for Color Values," by D. McFarlan Moore.

A resolution by E. L. Elliott that the New York section request the council of the society to take steps toward having some standard of white light defined and accepted, was duly seconded and passed unanimously.

Monorail Road for New York.

Construction work has been started on the new monorail system that will run from Marshall's Corners in the Bronx, through Pelham Park to City Island. The American Monorail Company, which is building the road, is headed by Bion L. Burrows, former secretary to the Rapid Transit Commission, and is connected with the Interborough Rapid Transit Company, which is furnishing the necessary funds. When completed the monorail will take the place of the City Island Railroad Company and the Pelham Park Railroad Company, the total mileage of the two lines being a trifle over three miles. Mr. Burrows states that construction work will be completed by August and operation will commence shortly after, as the cars are about ready.

Montreal to Have Subway.

According to advices from Montreal, capitalists there have a plan on hand by which they intend to construct an underground railway system under the city, and have applied for incorporation of the Montreal Underground and Terminal Railway Company, with a capital of $20,000,000. While the plans are indefinite at the moment, it is hoped before proceeding with the construction of a tube system, to bring about an amalgamation of the Montreal Light, Heat and Power Company, and the Shawinigan Water and Power Company, and in this way to have the leading interests in these concerns interested in the new company that will build the underground railway. It is said that necessity for such an underground system is likely to be felt more in Montreal than in even a very much larger populated city, owing to the situation of the city on the side of a mountain, resulting in the business section being very much congested.

The plans that the promoters of the new project have in hand seem to indiate that their intention is to start with the construction of an underground tube running from east to west, and in this way cross the entire town for a distance of about twelve miles. With this first tube completed, the construction of a second tube to run from north to south would be considered.

Twenty-Third Street Railway.

Judge Lacombe, in the United States Circuit Court, last week heard arguments and reserved decision on a motion of the Twenty-third Street Railway Company of New York city to have the Metropolitan Street Railway Company receivers impound and set aside the surplus earnings of the Twenty-third Street Company in a special account and held as a fund to meet the interest on the notes held by the Mercantile Trust Company of $2,200,000 and interest on $400,000 underlying bonds.

Counsel for the Twenty-third Street Company argued that the surplus earnings of their line, which are very great, are being diverted from the purpose for which they should be used by the receivers of the Metropolitan company, and if the receivership be ended and the road turned back to them they will be saddled with three years' interest on this $2,000,000 note and the $400,000 bonds.

Receivers of the Metropolitan claim that the Twenty-third Street road is well protected by the bond of the Metropolitan receivers.

Cheap Lighting Rate in Buffalo.

A report from Buffalo, N. Y., states that the Buffalo General Electric Company has made an offer to the city to light the temporary municipal building known as the Nardin Building at the rate of four cents a kilowatt-hour. The low figure is explained by the fact that the Catholic Diocese had offered the city a similar rate.

The Southern Power Company's System.

A Brief Story of a Most Interesting and Modern High-Tension Hydroelectric Plant.

BY J. W. FRASER.

The Southern Power Company was originated in the spring of 1905 to take over the Catawba Power Company, which had a 10,000-horsepower plant near Rock Hill, and to develop the remainder of the important water powers on the Catawba River. The Catawba Power Company was organized about three years previous to this time to develop what was known as the India Hook Shoals and had completed this plant early in the spring of 1904. The object was to furnish mills in the surrounding towns with power and light, principally the former, as the amount of current used for light in the nearby towns was insufficient to warrant the building of a 10,000-horsepower plant. Previous to this time very few of the mills in the South were operated from electric power, although one of the largest mills in South Carolina had been operating successfully as early as 1894, still the electric drive had made very little progress. When the organizers of the Catawba Power Company endeavored to sell power from this plant the mill men did not seem to have any confidence in this method of driving mills and the first few contracts closed were at a very low figure. As soon, however, as the first two or three mills were put in operation the confidence of the mill men began to grow and within a year the entire output of the plant had been sold and the demand for power had become so great that those interested in this older organization formed a larger one under the new name of the Southern Power Company, with the intention of distributing power to all mills within economical transmitting distance of the water powers mentioned above.

The first question that had to be decided by the engineers was that of voltage of transmission. It must be remembered that at this time there were only two plants in America operating at 50,000 volts and that some of our best engineers were still in favor of lower voltages, although many were advocating 60,000 and 70,000 volts. It was finally decided not to use higher than 50,000 volts, mainly due to the fact that there would be a great many small substations used for delivering

NINETY-NINE ISLANDS STATION.—FEBRUARY 2, 1909.

this power which, if a higher voltage was used, would cost more than the additional copper in the lines necessary at 50,000 volts, and also due to the fact that the greater part of the power that could be developed during the next three for four years could probably be sold within sixty miles of the generating plant.

Further, it was natural to conclude from the progress that had been made in the electric art that by the time the towns within a radius of sixty miles had been furnished with power that transmitting apparatus would be so improved that the towns lying beyond this sixty-mile radius could be reached economically. This conclusion proved to be correct, for by the autumn of 1908 plans were laid for a 100,000-volt system that would extend from Columbia on the South to Taylorsville on the North, and from Anderson on the East to Raleigh on the West. By the autumn of 1909 lines were completed from Great Falls to Greensboro and Winston-Salem and from Great Falls to Greenville, S. C. Substations have been built at all of the important towns these lines pass through, and at the points where the 100,000-volt lines touch the 50,000-volt system tie-in substations have been completed.

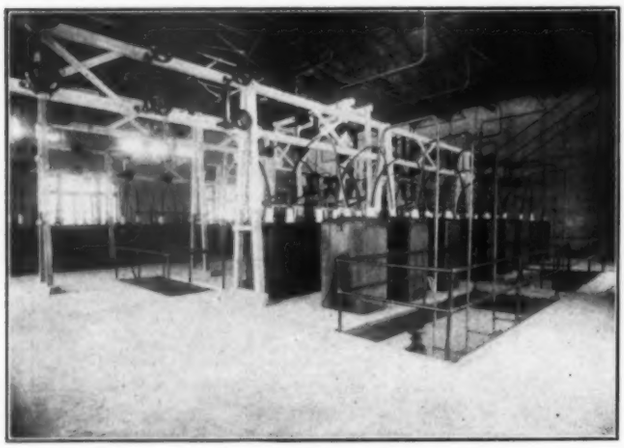
At the present time there are in operation nineteen 11,000-volt substations, thirty-three 50,000-volt substations, twelve 100,000-volt substations and four tie-in substations, aggregating in capacity of transformers 215,000 kilowatts.

These substations furnish power and light to forty odd towns and over 130 cotton mills. Power for operating mills is sold direct to the mill companies but for local lighting the power is in many cases sold in bulk to the local lighting companies for distribution.

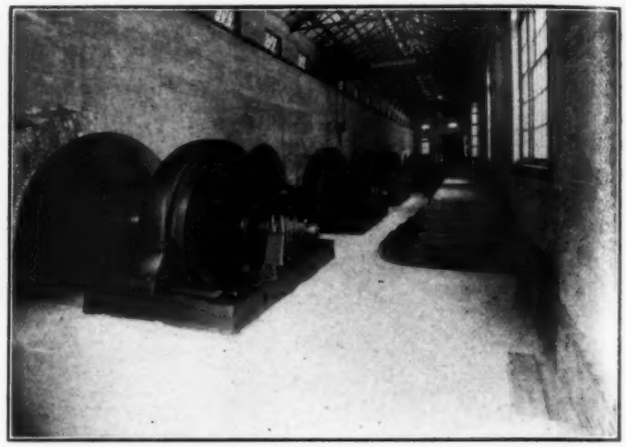
By referring to the accompanying map it will be seen that this system stands out as a notable example of distribution over a large area as compared with many other systems throughout this country which transmit from one or more plants to some central distributing point.

To transmit this power there have been completed:

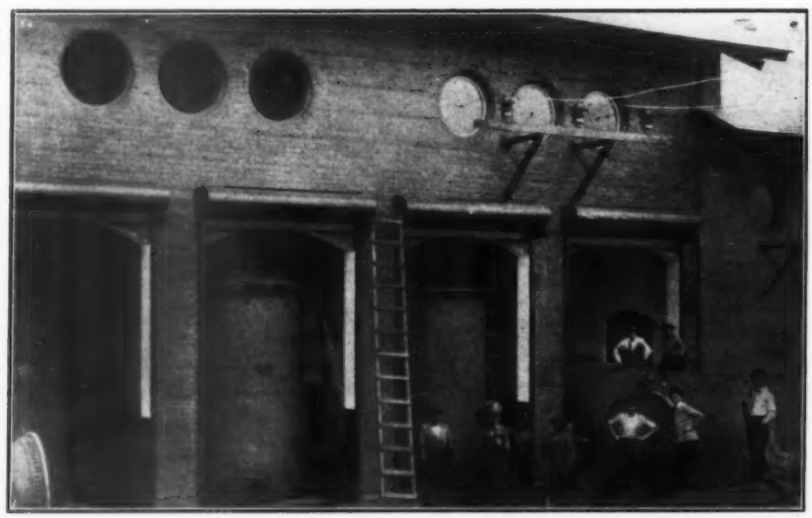
65 miles 11,000-volt wood pole line



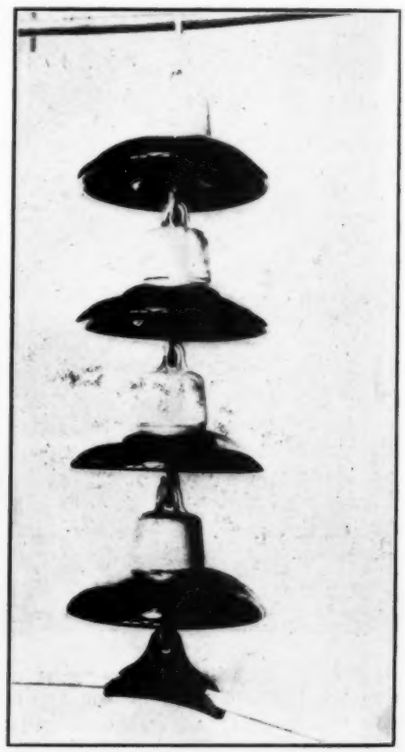
HIGH-TENSION SWITCH ROOM, GREAT FALLS GENERATING STATION.



GROUP OF EIGHT 5,200-HORSEPOWER TURBINES AT ROCKY CREEK GENERATING STATION.



12,000-KILOWATT TIE-IN STATION.—100,000 TO 50,000 VOLTS.

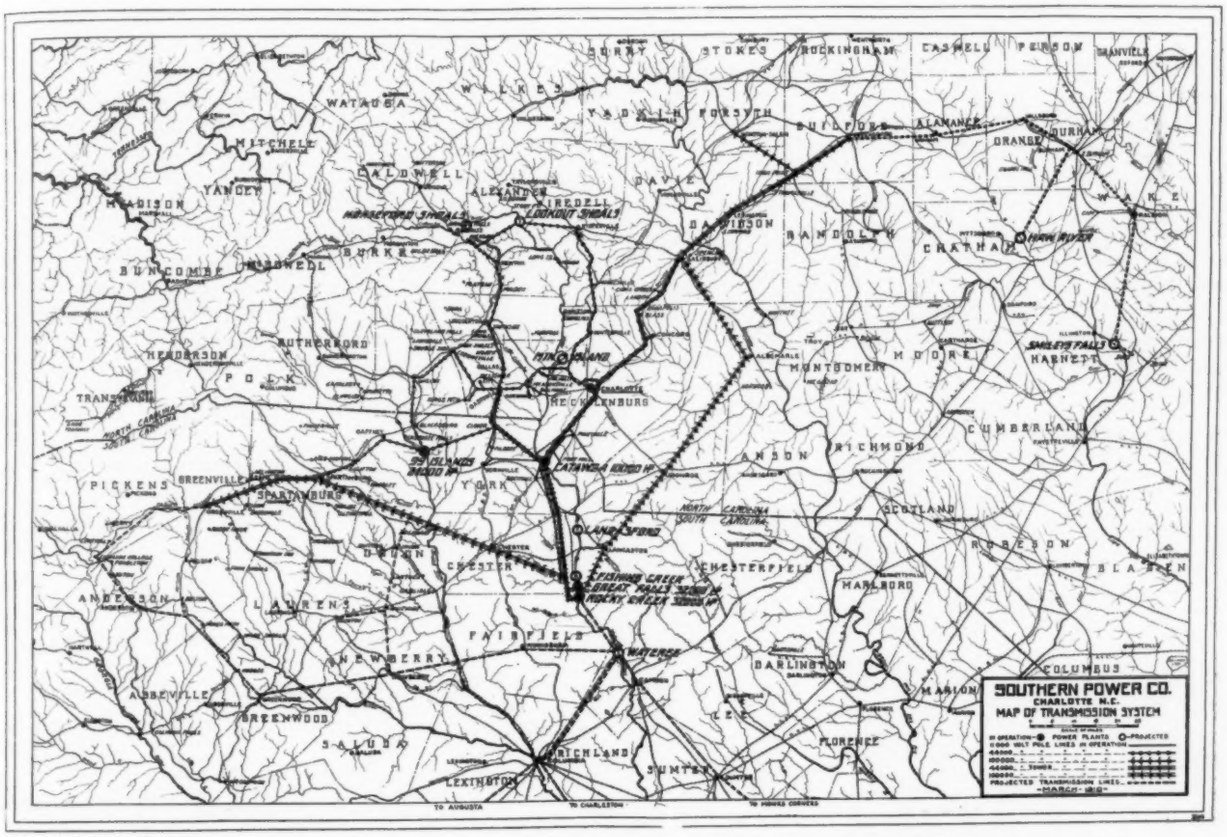


SUSPENSION INSULATOR AND CLAMP.

240 miles 50,000-volt single-circuit wood pole line
65 miles 50,000-volt double circuit wood pole line
55 miles 50,000-volt double-circuit tower line
260 miles 100,000-volt double-circuit tower line on part of which only a single circuit has been strung. In all about 900 miles of single circuit and about 150 miles of secondary circuits.

Power is supplied to these circuits from four generating stations: Catawba station, which was completed in the spring of 1904; Great Falls station, which was completed in the spring of 1907; Rocky Creek station, which was completed in the spring of 1909, and Ninety-Nine Islands station, which was completed early in 1910. These plants have an aggregate of nearly 100,000 horsepower.

The three stations completed since the organization of the Southern Power Company are practically identical with regard to design and apparatus installed, the head in each case being nearly the same. A type of unit, consisting of one 5,200-horsepower horizontal twin turbine connected to one 3,000-kilowatt three-phase sixty-cycle, 225 revolutions per minute 2,500-volt generator, has been standardized.



MAP OF TERRITORY SERVED BY THE SOUTHERN POWER COMPANY, SHOWING TRANSMISSION SYSTEM.

ROCKY CREEK DAM.

ROCKY CREEK GENERATING STATION.

Up to the present time only one steam auxiliary plant has been in service. A 2,000-horsepower plant has been installed to take care of the lighting load at Charlotte but there is now under construction a 15,000-horsepower plant at Greenville, S. C. It is expected that the company will be able to put this in service before the low water period of this year. Another of about this same capacity will be installed at once near the opposite end of the system.

As the generating plants and 50,000-volt transmission lines have been previously described from time to time, we will not repeat what has already been said but will give a short description of the recent 100,000-volt work, which may be of some interest.

The towers for the 100,000-volt lines

VIEW OF TRANSMISSION LINES—100,000-VOLT LINE TO THE RIGHT, 50,000-VOLT LINE TO THE LEFT.

have been designed to carry two circuits, the wires of each circuit being in a vertical plane, one circuit on either side of the tower. Conductors are eight feet four inches apart and the lowest conductor is forty feet from the ground. Four styles of towers have been used: suspension, strain, extra heavy strain and city poles. The suspension towers were designed to withstand a wind strain of fifteen pounds per projected square foot of conductor and thirty pounds per square foot of tower in addition to two conductors breaking. Strain towers were designed to withstand all wires breaking in addition to wind strain. Extra heavy strain towers were designed for spans over 1,000 feet in length, and the city poles were designed with a small base so that they would not take up much space in a street. No. 00 copper and aluminum is used on this line and the sag was so adjusted that under no temperature will the strain exceed one-fourth of the ultimate strength of conductor.

The anchors for suspension towers are made of a twelve-inch channel, thirty inches long and are placed six feet in the ground; anchors for strain towers are of the same dimensions but are placed eight feet in the ground. No concrete is used on these anchors except where the ground is very soft or on heavy angles. The reason for not using the concrete is because it was found that making concrete anchors in the field was very expensive, due to the following facts: Stone, water and cement have to be hauled a considerable distance and it is necessary to have a template and experienced men to set the anchors. The delay caused by the lack of stone, or water, or cement, etc., not only made the cost of the foundation excessive, but delayed materially the completion of the line. Tests made by the writer showed that even in sandy soil it took 24,000 pounds to pull out an anchor placed six feet in the ground and that an anchor placed eight feet in the ground could not be pulled out at 30,000 pounds.

A two-part suspension insulator was used, the diameter of the outer shell fourteen inches and the diameter of the inner shell seven inches. A cap was cemented on the top of the insulator and a hook cemented in the inner shell. Tests made showed that none of these hooks would pull out under 8,000 pounds, and in many cases the insulator stood over 12,000 pounds. Four insulators were used on suspension and five on strain.

Very little can yet be said with regard to the operation of this line, but from what little experience that has been already gained it appears that there will be less trouble on the 100,000 volt suspension line than on the 50,000 volt pintype towers.

Camden & Trenton Railway Sold.

Henry C. Thompson, Jr., of Philadelphia, representing the stockholders' committee, bought the Camden & Trenton Railway Company, under the sale ordered by the United States Circuit Court, at $675,000. The road is now in the hands of Wilbur F. Sadler as receiver. The line connects the Delaware River towns between Trenton and Camden.

The Dielectric Strength of Air.

With the use of increasing values of voltage for transmission of electric energy the question of the conditions under which the so-called "corona" is formed has assumed great importance. The term "corona" refers to the brush discharge which takes place from high voltage conductors above a certain value of the voltage. This discharge does not necessarily result in a short circuit, but is a cause of loss of energy and deterioration of insulation. For a given transmission line observations as to the voltage at which "corona" begins differ among several observes by as much as fifty per cent. There is much uncertainty as to the influence of atmospheric conditions, wave form, frequency, etc.

A series of experiments have been undertaken in the physical laboratory of Johns Hopkins University with the aim of controlling these several influences and of determining as far as possible the nature of the phenomenon of "corona."

In the present state of the work there is indication that the point of break-down or ionization of the air does not occur at a definite value of electric intensity, but is a function of the diameter of the conductor also. Further, observations on four sizes of the conductor indicate that, if there is any effect of moisture content in the air, the values of the voltage at which corona is formed is not influenced by more than two per cent; this applies to a range of moisture content from air which is quite dry up to the saturated condition. The influence of temperature is being studied and the preliminary results indicate that for a range of from zero to forty degrees, centigrade, there is a lowering of about three per cent in the value of the critical voltage.

The most striking result of the experiments so far is the indication that the air is ionized at different values of electric intensity for different sizes of wire.

Subway Side-Door Cars.

Side-door cars are now being received by the Interborough Rapid Transit Company, of New York city, at the rate of two a day. These cars are being pressed into service as soon as received and it is expected that the express service will be operated completely with side-door cars before July 1, next.

THE HEROULT ELECTRIC REFINING FURNACES.

BY J. B. C. KERSHAW.

Reference has been made in previous issues of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN to the fifteen-ton Héroult electric refining furnaces of the United States Steel Corporation, one of which was for the South Chicago Mills of the Illinois Steel Company, and the other for the Worcester Mills of the American Steel and Wire Company. The decision of the United States Steel Corporation was to use as raw material in these furnaces, the hot metal from Bessemer converters in the first case, and from open-hearth furnaces in the second; and in this way the electric furnace would form the last link in the chain of smelting and refining operations for converting the iron oxide of the ore into finished steel of high quality.

Thanks to the kindness of M. Héroult, the results obtained during some months' operation of the Chicago furnace are now available for publication, as are also the accompanying photographs of the similar furnace erected at Worcester, which started work late last December.

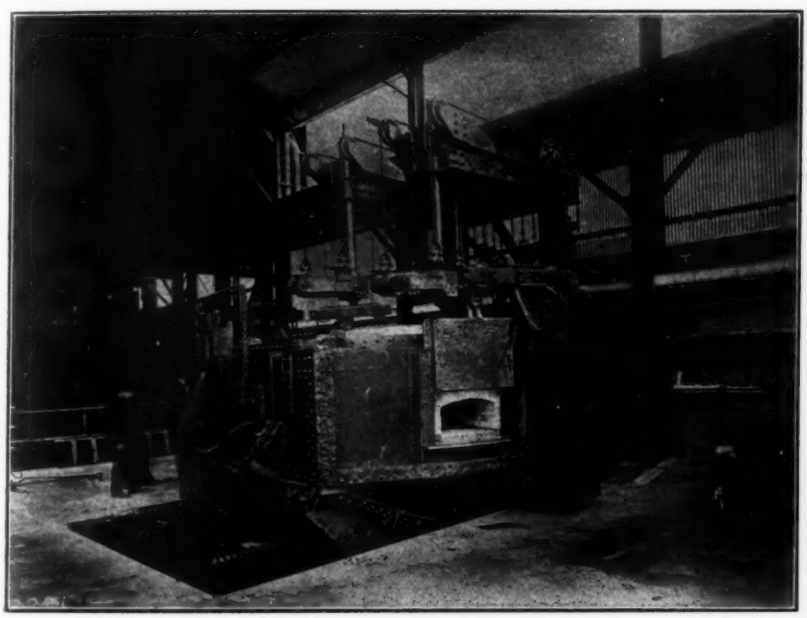
At the end of December, 1909, the South Chicago furnace had completed 1,000 heats, and had produced on the average 170 tons of steel per day. It is hoped to increase this output in the near future to 200 tons per day, but it is doubtful if the original estimate of 250 tons per day can be attained, with this size of furnace, even under the most favorable working conditions. According to Mr. Turnbull, M. Héroult's representative in New York, it is intended to build later in America (presumably for the United States Steel Corporation) electric steel refining furnaces of thirty tons' capacity. These will be employed for treating exceptionally pure raw material, since with this size of furnace only one treatment with slag will be possible, and no doubt in this case daily outputs of 400 tons per day will be attained.

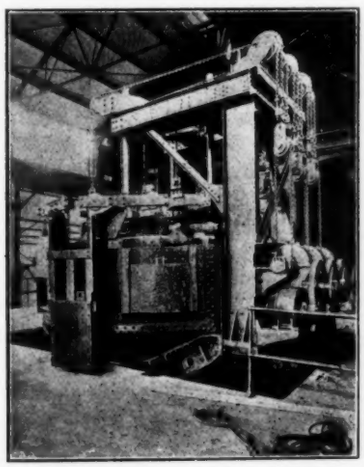
As regards the cost of renewals, the wear and tear on the lining of the furnace has been small, and while the repairs of the furnace roof have cost five cents per ton of steel, ten pounds of dolomite per ton have sufficed to keep the banks of the furnace in good condition, and the bottom of the furnace has required no attention at all. No figures have been given for the actual consumption of the electrodes, which in these furnaces are ten feet long by two feet in diameter and weigh each over 3,200 pounds, but it has been estimated that this will not exceed fifteen pounds of carbon per ton of steel, and that it may be as low as ten pounds.

As regards the cost of treatment and the quality of the steel produced, the Chicago furnace is employed in turning ordinary Bessemer steel into a high-grade steel for rails, car wheels and axles. M. Héroult states that the result of the three months' work show that the costs are less, and the mechanical test twenty per cent better, than for metal of the same chemical composition, produced by the open-hearth furnace and process.

The power consumption is believed to be between 100 and 150 kilowatt-hours per ton of finished steel, but no definite working figures have yet been published, showing how far the estimated saving in power has been realized, in these large furnaces. In the ordinary size of Héroult furnace (three tons) for cold scrap, between 700 and 864 kilowatt-hours are required per ton of finished metal. This is reduced to between 150 and 329 kilowatt-hours when the metal is charged in the molten state.

The power at South Chicago is supplied by three 700-kilowatt transformers, and this furnace (as is also the one at Worcester) is provided with three electrodes and is worked on the three-phase current system. It is understood that these are the first large Héroult furnaces to be worked in this manner, all the earlier furnaces having been operated by direct current. The views show the Worcester furnace (with the electrodes removed) from two points of view.





VIEWS OF THE FIFTEEN-TON HEROULT FURNACE AT WORCESTER, MASS.

It may be remarked in closing, that the chief feature of the electric refining process when using Bessemer steel for charging the furnace, is the elimination of the phosphorus and the sulphur by means of first an oxidizing and then a reducing slag. With open-hearth steel these impurities are much less in amount, and the refining process is proportionately shortened. Under ordinary

working conditions therefore the Worcester furnace should have the larger output.

At present there are in America three licensees of the Héroult furnace: The Halcomb Steel Company, of Syracuse, N. Y.; the Firth Stirling Steel Company, of McKeesport, Pa., and the United States Steel Corporation. It is expected that owing to the success of the Chicago and Worcester installations, a large number of additional licensees will be obtained.

Power Plant Merger in Pennsylvania.

A recent dispatch from Altoona, Pa., states that the Penn Light and Power Company, which recently merged the two power plants in that city, has obtained control of the Tyrone Electric plant, Huntingdon Gas Company, Lewistown Electric Railway and Gas Company, and the Juniata Water and Power Company, at Warriors' Ridge.

These embrace all the illuminating and power plants between Altoona and Lewistown. Altoona will be the headquarters of the consolidated concern, with E. T. Penrose, of Tyrone, as general manager, and E. R. Greene, of Altoona, general superintendent.

Los Angeles Electric Club.

The Los Angeles Electric Club, which was conceived early in 1907 with the object of fostering the spirit of cooperation in the local electrical industries, has now become a flourishing organization. At first no regular organization was formed, the members only meeting informally each week at a luncheon. Later a semi-organization was formed, with H. Conger Bowers as chairman. This body continued to meet weekly until October, 1909. At this time it was decided to perfect a permanent organization and to maintain the attendance and interest, the meetings were to be held monthly. Accordingly at the meeting last November a chairman and secretary and treasurer were elected and an executive committee appointed. Later a vice-chairman was also elected. The club, which numbers about 125 members meets on the second Thursday of each month at the Hollenbeck Hotel, where after luncheon a speaker is provided for each meeting.

The officers are: Chairman, A. W. Ballard, manager General Electric Company, Los Angeles; vice-chairman, Chas. W. Walton, general agent Southern California Edison Company; secretary and treasurer, R. B. Clapp of the Westinghouse Electric and Manufacturing Company.

The executive committee is comprised of J. A. Lightipe, Southern California Edison Company; C. E. Warner, Pacific States Electrical Company; H. P. Hubbard, Forve Pettibone Company; C. G. Pyle, Standard Underground Cable Company; H. B. Woodill, Woodill, Hulse Electric Company; E. R. Northmore, Los Angeles Gas and Electric Company.

Advice to the Electrical Graduate on Seeking a Position.

In a recent letter to the editor of *The Tech*, Clarence Renshaw, a graduate of the Massachusetts Institute of Technology, gives some good advice to the new-fledged college graduate who is about to go out into the world to make his living. The following excerpt is given in full:

"No matter how excellent a college training a young man may have had, or how much he may have profited by it, should he enter the apprenticeship course of one of the large manufacturing companies, his first few days at work are likely to prove one of the most discouraging experiences of his life. Coming from a college, where several years of attendance have made him familiar with every detail of the surroundings, he finds himself almost lost in the vastness of a large factory. It was difficult enough for him to begin recitations at nine o'clock, but now he must report for work at seven. The subjects which he has been pursuing for the past four years seem absolutely useless in his new surroundings, and entirely different standards seem to prevail. And, somewhat like the Irishman who visited France and was greatly surprised to find even the little children on the streets speaking French fluently, while he, a grown man, was entirely ignorant of it, so our erstwhile lordly Senior finds that apparently he alone, of the thousands of working men, women and children around him, seems not to know what tasks are expected of him or how to perform them. This feeling soon wears off, however, and he begins to be interested in his work and to realize the possibilities for learning which are within his grasp.

"With reference to the value of such courses, and the advisability of entering one of them at a salary of about $40 per month, rather than taking a regular position, if one can be obtained, at $50 or $60, I would certainly advise the former for all young graduates who can possibly arrange for it. I did not feel this way at the time of my own graduation, but experience sometimes causes us to change our ideas on many points.

"To the man in a hurry to place himself on a dividend-paying basis, I would say that the taking of such a course is in the nature of waiting a few hours for a train to take one on a journey of a hundred miles, or so, rather than impatiently starting out at once to walk. One is often inclined to feel that in so large a plant an individual is lost sight of, and finds it difficult to advance. This is really not the case at all, however, and it is surprising how soon a capable apprentice is heard of by department heads. Even if one does not expect to remain with the manufacturing company, the training offered by such a course forms a most excellent basis for securing good positions elsewhere."

Twenty-third Street Railway Suit Remanded.

Upon the application of Edward R. O'Malley, Attorney General of the State of New York, Judge Coxe in the United States Circuit Court, granted an order remanding to the Supreme Court of the state the suit of the people of the state of New York against the Bleecker Street & Fulton Ferry Railroad Company, the Twenty-third Street Railway Company, and the Metropolitan Street Railway Company. The suit is for the forfeiture and annulment of franchises granted to the defendant companies covering portions of the street railways, the use of which has been abandoned, and for the removal of the tracks which are no longer used.

Subway Bridge Loop Completed.

The Manhattan tunnel of the subway bridge loop in New York city has been completed. The cost to date is $10,000,000. The loop connects the Manhattan and Williamsburg bridges, and is eventually to connect Manhattan and Brooklyn at the proposed Fourth avenue and Williamsburg tunnels. The New York Public Service Commission has asked the Board of Estimate for an appropriation of $2,000 for the maintenance of the loop until contracts for equipment and tracks are placed.

Minneapolis Electric Show.

Preparations for the Minneapolis Electric Show to begin April 2, are now well under way, and much is being done to make this of not only of local, but general interest. Assistance in these plans is coming from many sources.

The Electric Engineering department of the Minnesota University is going to make a historical exhibit, which will show types of old fashioned motors, telephones and telegraph instruments, together with apparatus of the invention and construction by students of electricity. This is to be given a prominent location so that the contrast with modern inventions will be noticed. The only motion pictures in this country, illustrating the demonstrations of the gyroscope monorail car, both in England and Germany, will be shown in connection with lectures by Prof. M. M. Wood, who will also exhibit working models.

The show is being extensively advertised throughout the Northwest and exhibitors can be assured of a very large attendance. The following exhibitors have already been assigned space:

Minneapolis General Electric Company, Fairbanks, Morse & Company, Minneapolis Electric Motor Company, New England Furniture & Carpet Company, American School of Correspondence, Chicago, Ill., ELECTRICAL REVIEW AND WESTERN ELECTRICIAN; W. O. Hartig Electric Company, Vernon Bell & Company, Pike Electric Company, Minnesota Electric Company, Walter W. Geisse, Westinghouse Electric and Manufacturing Company, Minneapolis Gas Fixture Company, Hurley Machine Company, Chicago, Ill.; The Electric Shop, Empire Vacuum Company, New York city, N. Y.; Loberg Gas and Electric Fixture Company, American Multigraph Sales Company, Safety Insulated Wire and Cable Company, Burroughs Adding Machine Company, Western Electric Company, I. A. Bennett Company, Chicago, Ill.; Northwestern Telephone Exchange Company, Electrical Engineering Company, Crane & Company, American Bank Protection Company, Bishop & Babcock, St. Paul, Minnesota; Stroud Humphrey Manufacturing Company, Hastings, Minn.; Central Electric Company, Chicago, Illinois; Stolz Electrophone Company, Chicago, Illinois; Hollis Electric Company, Studebaker Brothers Company of Minnesota; Santo Sales Company, Olson & Becker, St. Paul, Minn.; Columbus Electrics, B. M. Laird, Duntley Manufacturing Company, Chicago, Ill.; *Popular Electricity Publishing Company*, National Electric Lamp Association, Cleveland, Ohio, Northwestern Electric Equipment Company, St. Paul, Minn.; Pierson-Wilcox Electric Company, General Electric Company, Cadwell & Brown Company.

In addition to these exhibitors, many others have practically reserved booth space so that at least one hundred exhibitors' booths are assured.

New York Edison Stock Authorized.

The application of the New York Edison Company to issue $5,349,400 new stock has been granted by the New York Public Service Commission. When issued this will make the amount of stock outstanding $50,400,400. The application was granted with the usual reservations.

Of the new issue $4,312,000 are to be devoted to paying off an equal amount of five per cent bonds, issued by the Edison Electric Illuminating Company of New York which matured March 1, and $790,400 to pay off $988,000 of bonds issued at eighty by the Mount Morris Electric Light Company, which are now redeemable, and $247,000 for extensions and additions to the plant and distributing system of the New York Edison Company.

Municipal Exposition for Chicago.

Invitations have been sent out to the mayors of all cities of over 50,000 population, to participate in the International Municipal Congress and Exposition, to be held in Chicago in September, 1911. Details of the exposition will be arranged at a meeting of the convention bureau of the Chicago Association of Commerce.

E. H. Allen has opened offices in the Great Northern building, and will look after the exposition features of the congress.

Iowa Street and Interurban Railway Association.

The annual meeting of the Iowa Street and Railway Association will be held at Sioux City, Iowa, on April 21, 22 and 23. A number of very interesting papers will be read, among which is one on track and overhead construction. The conditions in the city will be treated by J. G. Hunton of Davenport, while the interurban side will be considered in the paper by F. J. Hanlon of Mason City. Other papers on the financial and legal side of railway operation will be presented.

In addition to the formal numbers, problems encountered by those doing actual operating work will be discussed.

The present officers of the association are: P. P. Crofts, president; E. M. Walker, vice-president; L. D. Mathes, secretary and treasurer.

Electric Light Contract at Caracas.

Consul Isaac A. Manning, of La Guaira, reports that the Government of Venezuela has entered into a contract with the Compania Anonima del Gas y de Luz Electrica, of Caracas, by which the former agrees not to establish a government system of lights for four years, which may be extended four years more, and redelivers to the company all its installations, posts and lines which had been reserved by the Government in its contract of May 24, 1909. The company agrees to extend the public lighting service until the number of lights reaches 600, and to reduce the price from $0.51 to $0.386 per day, and also to reduce the prices for government buildings.

The work of extension of service must be commenced within six months and completed four months later.

McCall Ferry Power Receiver Discharged.

In the suit of the Knickerbocker Trust Company against the McCall Ferry Power Company, Judge Lacombe of the United States Circuit Court, filed an order approving and confirming the report of the Henry B. Brown, special master in the case, and discharging Receiver J. D. Aldred. The receiver's supplemenal report shows that he has paid to the Pennsylvania Water and Power Company $139,443, amount of its claims as assignee of William M. Barnum, who purchased under foreclosure all the property and assets of the McCall Ferry Power Company.

Brewery Company to Build Power Plant.

The Peter Breidt City Brewery Company, of Elizabeth, N. Y., has obtained a permit from the building inspector of that city to erect a power plant which it is estimated will cost $5,277. The electrification of the brewery machinery is contemplated.

Joint Banquet of the A. I. E. E. and Sons of Jove in California.

The joint banquet of the American Institute of Electrical Engineers and Sons of Jove, which was held on March 12 last at the Hollenbeck Hotel, Los Angeles, Cal., was one of the most successful and enjoyable meetings of electrical men which has ever been gotten together in southern California. About 115 representative electrical men engaged in various lines of the industry were present, and the banquet was followed by a number of addresses.

A. W. Ballard acted as toastmaster, the first speaker introduced being C. W. Koiner, chief electrician of the city of Pasadena, who spoke on the "Institute." In the course of Mr. Koiner's talk the speaker drew attention to the fact that the A. I. E. E. membership in Los Angeles is ninth in point of number in the country and second west of Chicago. Mr. Koiner expressed the hope of Los Angeles securing the national convention of the A. I. E. E. this year or at least next year.

Following Mr. Koiner, E. R. Northmore, of the Los Angeles Gas and Electric Company, in his paper on "The Lighting Companies" gave a resumé of the development of the electric public utilities in Los Angeles and vicinity.

E. F. Scattergood, who is electrical engineer for the Los Angeles Aqueduct Commission, then gave a talk on "Engineering," in which he urged the cooperation of engineers and deprecated their taking up work in a branch for which they were not properly fitted.

After a short musical selection by a local quartette, J. A. Lighthipe, president of the local branch of the A. I. E. E., entertained those present by interesting and amusing experiences in the "Early Days in Thos. A. Edison's Laboratories."

"The Reclamation Service" was the subject of an address by O. H. Ensign, engineer in the United States Reclamation Service, and much interest was displayed in hearing of the great work in reclamation that is being carried on in the arid regions of the West.

A brief talk on "Contracting" was made by H. B. Woodill, of the Woodill-Hulse Electric Company, in which was reviewed the progress made in this branch of business in Los Angles since 1893.

Among those present, much to the pleasure of the assemblage, was Dr. F. B. Crocker, who is on his way to New York from a trip around the world. Doctor Crocker, who was called upon for a few remarks, expressed his gratification at the large attendance and at the interest displayed, and gave some interesting personal reminiscences as far back as the organization of the A. I. E. E., at which about thirty scientific men (only a few being in the electrical line) were present. Doctor Crocker also gave a brief talk on the electrical development in Oriental countries from which he is just returning. The conservatism and slowness of electrical progress in India and the possibility of great development of water power there (where the rainfall in some places is as much as 200 inches a year) were remarkable. Doctor Crocker stated the possibility of 50,000 to 100,000 horsepower being easily developed not far from Bombay. In Manila, American conditions prevail, and electrical progress flourishes. There are some very good traction systems there, he said, which are well run and financially successful. Conservation in China is great, and Doctor Crocker stated that very little development could be noticed since he was there eleven years ago, and that the awakening in China was very much slower than most people think. In Japan, despite a financial depression and the fact that most business is not active, a veritable boom in electrical development is to be noticed. An interesting light was thrown on the development of telephone lines which in all Oriental countries is slow. The Oriental does not seem to care to do business over the telephone, whereas facilities for traveling and lighting by electrical means are much sought for in some Oriental countries.

The programme of the evening was terminated by A. W. Ballard, manager of the Los Angeles office of the General Electric Company, who spoke on the "Sons of Jove," giving its purposes and objects and extending an invitation to all electrical men present to join.

Pennsylvania Tunnel to Open May 15.

Announcement has been made by Ralph Peters, president of the Long Island Railroad, that commuters on the North Shore division will soon share in the benefits and comforts of travel via the new tunnels under the East River, as the new steel cars will run into the big Manhattan station by May 15.

President Peters says: "We will operate trains into the Manhattan station by May 15, when we put our spring schedule into effect. We have under construction 140 steel cars, 115 of which are to be motor cars for our electric lines. The contracts which were made last year provided that the deliveries of the cars would be made between February and May of this year. The car builders have been unable to carry out their contract as to delivery, and we will not receive any of these cars until May or June. We have fifty cars provided with motors, and these will be ready for service on May 15.

"It has been our intention all along to maintain the electric service on the Far Rockaway branch from New York, to run a few trains to Jamaica, and to connect with one or two divisions there, and run a shuttle service between New York and Winfield to connect with some of the North Shore trains."

The Charlotte Meeting of the American Institute of Electrical Engineers.

The meeting of the American Institute of Electrical Engineers at Charlotte, N. C., will be held March 30 and 31, and April 1. The official headquarters will be at the Selwyn Hotel, which is on the European plan. Other hotels in Charlotte are the Buford, European and American plan; Stonewall, European plan, and the Central, American plan.

The local committee of arrangements has provided for a number of pleasing social features and of several excursions to power plants and cotton mills. This being the first meeting of its kind to be held by the Institute it is hoped that as many as can will attend and contribute to its success.

The technical program has been announced as follows:

"Economics of Hydroelectric Plants," by W. S. Lee.

"Electric Drive in Textile Mills," by A. Milmow.

"Gas Engines in City Railway and Light Service," by E. D. Latta, Jr.

"A Method of Protecting Insulators from Lightning and Power Arc Effects with Results of Its Installation on the Lines of the Niagara and Lockport Power Company," by L. C. Nicholson.

"Modifications of Hering's Laws of Furnace Electrodes," by A. E. Kennelly.

"Some Demonstrations of Lightning Phenomena," by E. E. F. Creighton, illustrated by experiments.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring.

ELECTRICAL CONDUIT CONSTRUCTION.

EXAMPLES OF SOME RECENT PRACTICE.

The following article deals with the latest extension, on Hoopes Avenue, of the municipally owned electrical subways of Auburn, N. Y., and with recent developments of electrical conduit construction in Boston, Mass.

HOOPES AVENUE SUBWAY, AUBURN, N. Y.

In the construction of this section, several features, due to W. Thomas Wooley, then city engineer, and not found in other parts of the system, have been introduced.

The work now completed consists of one main line of eight-duct multiple tile conduit 1,050 feet long. This run is intercepted by four double manholes. Out of the manhole terminating the main run in one direction, run dead-ended lines of conduit east and west on Walnut Street, to tie in with the general system later.

In addition to the main conduits, fiber duct laterals run out of all manholes; in general, to the rear property lines of lots fronting on Hoopes Avenue. These runs terminate in iron riser bends of thirty-six-inch radius. A total of nine laterals were built, containing from two to five ducts each.

Fig. 1 shows the general plan, from which it will be noted that with the system of main runs and laterals adopted at Auburn, a conduit in one street removes the light and power, telephone, telegraph and other overhead wires, not only in that street, but also in one adjacent parallel street. Thus a maximum area is served by a minimum conduit outlay.

The details of the main conduit are shown in Fig. 2. Virtually there are two four-duct main runs separated by a five-inch concrete wall. One run is used for high-tension cables—the word in this instance being used to differentiate wires carrying light and power from those used for telephone and signal service. Three-and-one-half-inch square-bore multiple tile was used, laid with metal wrappers and a full encasement of three inches of Portland cement concrete mixed 1:3:5.

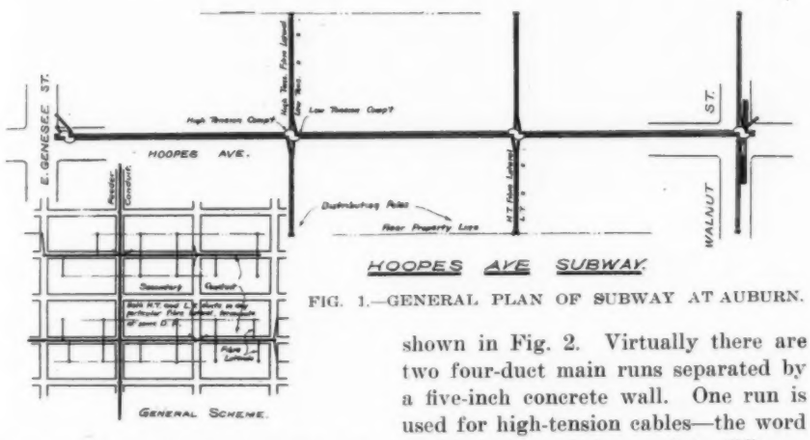


FIG. 1.—GENERAL PLAN OF SUBWAY AT AUBURN.

On approaching manholes, the high-tention and low-tension ducts were flared to enter their respective compartments. There are two separate and distinct compartments especially adapted to the correct racking of cables on walls. The compartments measure five feet by nine feet by six feet six inches headroom, with eight-inch brick walls. Staggering with respect to each other allows of main and lateral conduits being built into each compartment from every direction without passing through the other. In this way cables and connections of one potential are completely isolated from those of another potential, a condition greatly to be desired in municipal systems particularly, and difficult of accomplishment with any other type of manhole. How well this construction idea works out in practice is illustrated in the Walnut Street manhole, Fig. 3, where four main runs were taken out of each compartment in addition to a total of twelve lateral ducts out of the two holes; all with ease and without interference in any way.

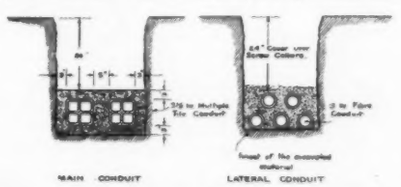


FIG. 2.—DETAILS OF MAIN AND LATERAL CONDUITS.

Another feature of these manholes is the copper ground-plate common to both compartments, five feet by five feet by one-sixteenth of an inch. The plate is imbedded in coke and provided with lengths of 500,000-circular-mil stranded copper cable, that reach up into each compartment to a height convenient for bonding to cable sheaths.

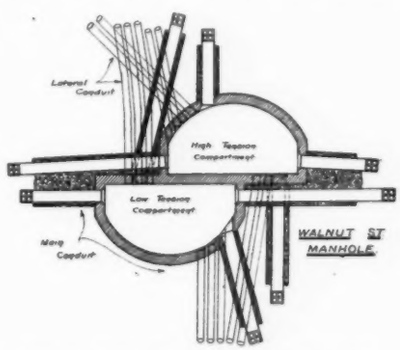


FIG. 3.—WALNUT STREET MANHOLE.

The fiber duct used was the three-inch screw-joint type, laid without encasement of any kind, and with twenty-four-inch cover. Roughly, 5,300 feet were involved. This pipe is especially heavy and durable. Lengths are five feet long, seven-sixteenths of an inch thick and provided with flat V-threads and heavy couplings. The breakage on this work was insignificant, although carried out, as it was, under trying weather conditions. The great major-

ity of lengths were screwed together by hand. On a small percentage pipe tongs were employed. Couplings were screwed in place on pipes above ground, the unit carried to the trench and screwed to the preceding length by the pipe layer. In this manner one pipe man and three helpers placed

tered, wrought-iron pipe was employed for lateral ducts, bent cold on the work by using a convenient sewer head.

The work was carried out by the construction department of the Safety Insulated Wire & Cable Company, of No. 114 Liberty Street, New York, under the supervision of W. Thomas Wooley,

plying this and the surrounding districts with light and power, telephone, telegraph and other electrical service.

The work was divided into three sections; Charles Street, Boston, to Lock; Lock to Sluice; Sluice to Commercial Avenue, Cambridge.

The first section was constructed by

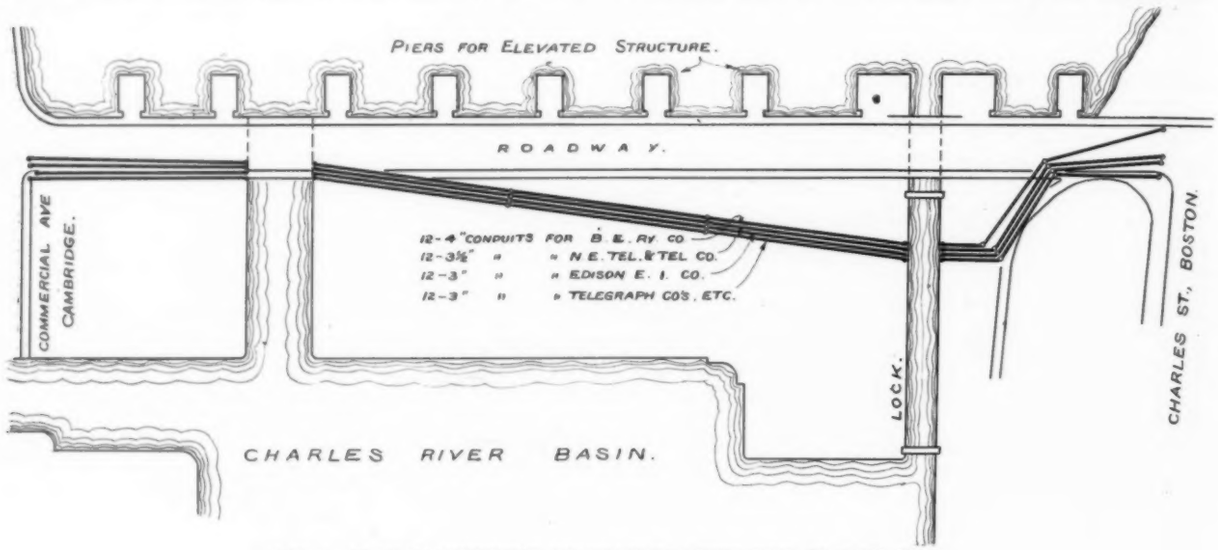

PIERS FOR ELEVATED STRUCTURE.
ROADWAY.
COMMERCIAL AVE CAMBRIDGE.
12-4"CONDUITS FOR B. E. RY. CO
12-3½" " " N.E. TEL. & TEL CO.
12-3" " " EDISON E. I. CO.
12-3" " " TELEGRAPH CO'S, ETC.
LOCK.
CHARLES ST., BOSTON.
CHARLES RIVER BASIN.

FIG. 4.—PLAN OF CONDUITS ON CHARLES RIVER DAM, BOSTON, MASS.

somewhat over 1,000 feet of duct per day. This, as before stated, was under the most severe weather conditions and included the setting and anchoring of bends.

Connection was made between lateral and riser bend by using the standard fiber collar. The annular space due to the different thicknesses of iron and

then city engineer. W. H. Rodier is superintendent of construction of the company.

CHARLES RIVER DAM, BOSTON.

A somewhat different construction was that forming a part of the great work of civic improvement being carried out in Boston, Mass., by the Charles River Basin Commission.

W. H. Ellis, of Boston, as part of a larger general contract. The third section was installed by the commission. The second, or the middle section, which constituted the main body of the work, and which is described herewith, was carried out by the same company which built the Auburn subway, described above, namely, the Safety In-

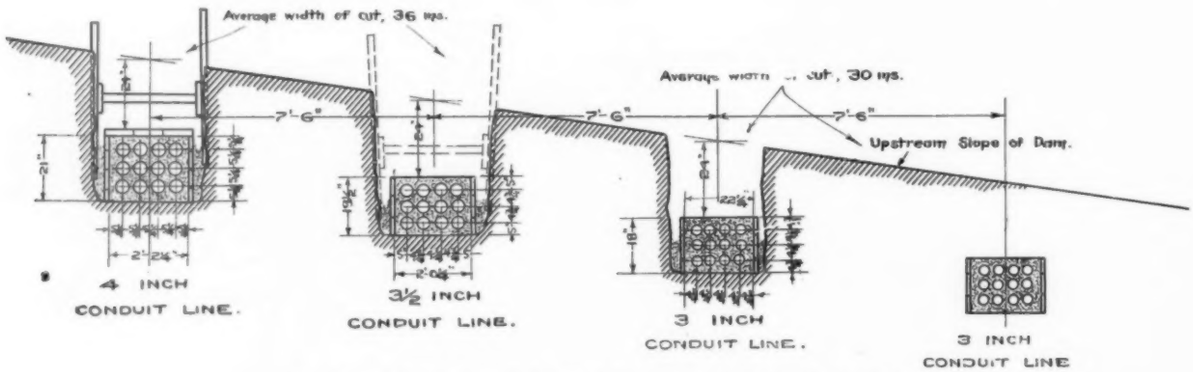


FIG. 5.—FOUR PARALLEL LINES OF FIBER CONDUIT AT BOSTON.

fiber pipe was taken care of, and the bend centered, by placing symmetrically, and driving, four small iron liners of proper thickness. The joint was then grouted thoroughly. The bends were anchored by cement mortar in which large stones were imbedded.

Where obstructions were encoun-

The conduits are placed on the upstream slope of the Charles River Dam, which it is proposed to convert into a city park. The subways will convey underground from Boston to Cambridge a large proportion of the great and growing volume of electrical circuits that cross the Charles River, sup-

sulated Wire & Cable Company. Practically the same construction methods were employed on all three sections.

The work (see Fig. 4) consists of four parallel lines of twelve-duct fiber conduit, each approximately 1,700 feet long, for railway, light and power, telephone, telegraph and municipal use

respectively. These lines are built about seven and one-half feet on centers. Each run is intercepted by eight manholes, exclusive of terminal holes, which therefore subdivide the runs into sections with an average length of about 190 feet.

Fig. 5 shows a cross-section of the four conduit lines—four inches, three and one-half inches and three inches. Socket-joint fiber conduit was used. Lengths were staggered, and all joints were dipped into a liquid mixed on the work, composed of equal parts of linseed oil and filler. This compound, while filling the joint, and preventing the cream of the concrete from entering and obstructing the duct at the joint, also has the advantage of being less viscous and tenacious than compounds in general use, which retard the pulling in of cable. The joints were further protected by a wrapping of cheese cloth.

The correct spacing of ducts was accomplished without the use of wood separation strips, as it was found that by keeping one man regularly on the one operation and providing him with the proper tool he soon became adept in tamping concrete with the ducts in such a way that the right spacing was maintained, and the well-known disadvantages of the strips obviated.

Trenches were alined and graded with instruments. Batters of grade boards were erected every fifty feet, and after coming to within six inches of grade a center line was strung between batters and finished grade secured from this. The same line was employed, using a plummet, to aline sideboards. These were cleated at the proper distance apart, and then lined up on each side of cord. Earth was then filled in behind the boards firmly before there was any opportunity to shift.

All sideboards were left in the trenches as a protection, additional to the concrete. The runs, where they came underneath the paved street which crosses the dam, were further protected by two-inch spruce topboards.

The short center distance between trenches allowed of an interchange of surplus material from one trench to another on this work, a condition not frequently met with, and one considerably expediting the construction.

Fig. 6 shows a conduit run under construction. Fig. 7 illustrates the proximity of trenches and shows the lines of batters.

The manholes were built four feet by six feet by six-foot headroom. They are built entirely of concrete throughout, of "barrel" plan and with eight-inch walls.

Manholes were built in set of four each, spaced seven and one-half feet on centers. On account of the site of the work being newly made ground, the sides of the excavation could not be used as an outside form, nor could the excavation sheeting be used for this purpose on account of the pressure against it. One large sheeted excavation was therefore made to include all four manholes, for which it was necessary to build both inside and outside collapsible forms, details of which are shown in Fig. 8.

On parts of the work the ground was considered too spongy properly to support the conduits. At these points, accordingly, the trench was deepened, an extra thick concrete floor was placed, and in this additional concrete were imbedded sixteen-foot lengths of two-inch plank.

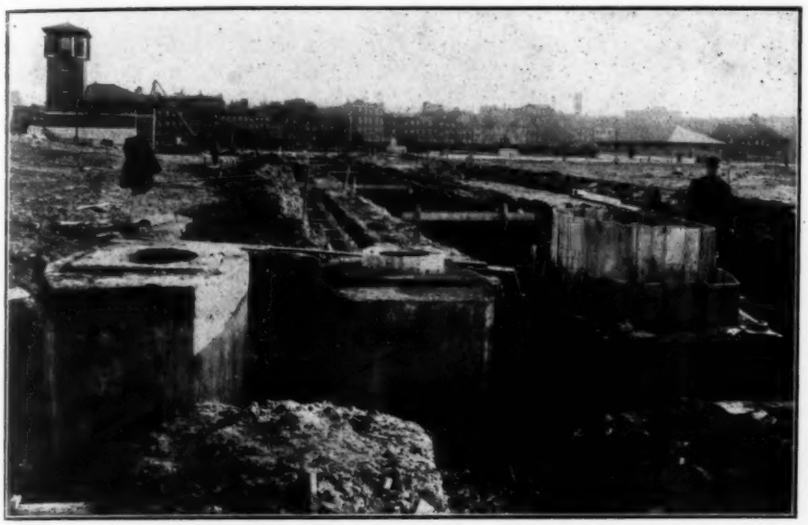


FIG. 7.—FOUR PARALLEL LINES OF CONDUITS AT BOSTON, 1,700 FEET LONG.

FIG. 6.—CONDUIT RUN UNDER CONSTRUCTION.

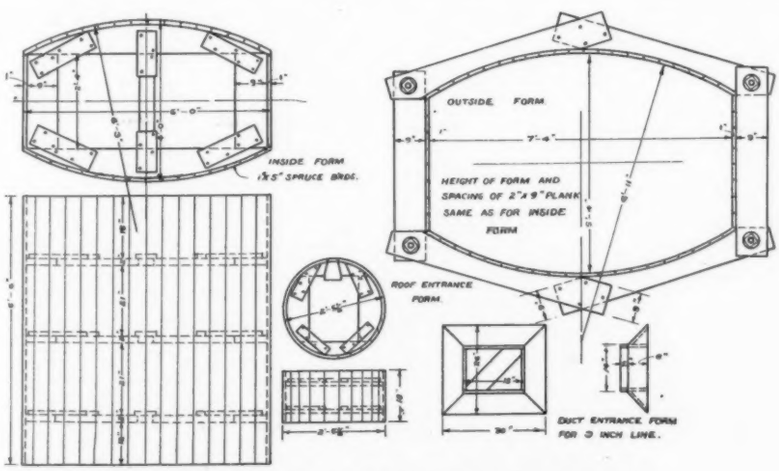

INSIDE FORM
1"x5" SPRUCE BRDS.
OUTSIDE FORM
HEIGHT OF FORM AND SPACING OF 2"x 9" PLANK SAME AS FOR INSIDE FORM
ROOF ENTRANCE FORM
DUCT ENTRANCE FORM FOR 3 INCH LINE.

FIG. 8.—DETAILS OF COLLAPSIBLE MANHOLE FORMS.

BALANCERS FOR THREE-WIRE SYSTEMS.[1]—II.

BY A. G. COOPER.

The latest form of continuous-current balancer is known as the C. M. B. (see Fig. 8). This machine has only one armature, one commutator, and one set of brush gear. This type has several advantages over other types of continuous-current balancers, such as high efficiency, combined with close regulation, small weight, and floor space occupied, little wear and tear as the machine is run on ball-bearings. It will be noticed that the armature which is ring-wound is divided into two equal parts by the short-circuited brushes; the polar limbs are all equal in dimensions. The series compounding coils are arranged on all the poles, not only for the purpose of regulation of voltage, but also to balance the circulating current across the short-circuited brushes. It will also be noticed that the shunt coils are cross-connected.

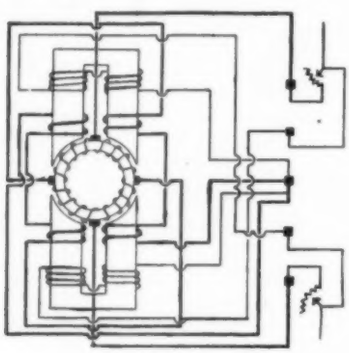


FIG. 8.

These efficiencies of these machines are four or five per cent higher than can be obtained with two machines coupled together, and the price at the same time is lower.

The use of static balancers or equalizers in this country (England) has mostly been used in connection with rotary and motor-converter installations as it lends itself very readily to this class of work by making use of the secondary coils of the transformer, by connecting the middle wire of the system to the star point of the secondary coils of the transformers which are supplying the rotaries. This is bad from an efficiency point of view; it is better to use a separate static balancer than the secondary coils.

1 Abstract of a paper read before the Manchester (England) section of the Institution of Electrical Engineers, February 8, 1910.

The static balancer consists of a choking coil or a transformer core, wound with only one winding on each limb according to the number of phases used. The terminals are connected to equally spaced connections round the armature of the dynamo to give the selected phase proposed to be used. From the slip-rings an alternating electromotive force is obtained which is connected to the terminals of the choking coil shown in Fig. 9 as a four-pole for clearness, which in this case is a

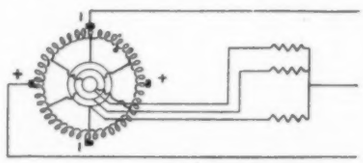


FIG. 9.

three-phase balancer; the star point is connected to the middle wire. When the system is balanced, there will be a strong choking action which will prevent any large flow of alternating current from the slip rings. When an out-of-balance current flows through the balancer and the armature there will be a drop in volts due to the resistance, but this will be shown later to be practically no greater than in most balancers, if the static balancer is suitably designed.

The advantage of a static balancer, compared with an ordinary balancer, is that in the former case there are only brushes running on slip rings, as compared with brushes on commutators, armatures, field coils, bearings and starter, and also greater space required. They are high in efficiency and automatic in action.

I find that some makers prefer single-phase, others two-phase and three-phase, but Doctor Garrard has shown that the greater the number of phases used, the better for regulation. For single-phase he gives a difference of voltage worked out on an assumed internal drop in the armature on a ten per cent out-of-balance as 0.66 per cent, three-phase 0.58 per cent ,and six-phase 0.49 per cent, but I hardly think from a commercial point of view that it would be advisable to have more than three phases, unless the slip rings are brought outside the bearings, as the increased length of the armature shaft will necessitate a larger diameter and a larger bearing, which in a big machine would run up the expense, besides being undesirable mechanically.

The author has installed a 360-kilowatt, eight-pole dynamo 520 volts, 700 amperes, 350 revolutions, fitted with slip rings which are large enough to use the machine at full load as a three-phase alternator if required. The static balancer is designed to deal with an out-of-balance load of 170 amperes. The machine has a compound winding for traction purposes only, so it is run as a shunt machine when using the static balancer. It might be as well to mention here, that in the event of using a static balancer with a compound wound, or a machine with commutating poles, the series winding must be split, half being connected in the negative side and half in the positive side of a generator, otherwise the static balances will not give the true middle—viz., the volts will not be equal between the middle wire and each of the outers, due to the lost volts in the series winding.

Of course, this will not be noticed at no load, but the difference will be greater as the load increases.

To take an example, assuming that at full load the resistance of the series turns causes a loss of one per cent of the armature volts in a 500-volt machine, the neutral and one of the outers would be five volts higher than the

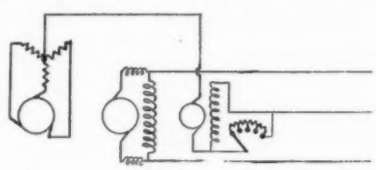


FIG. 10.

neutral and the other side in which the series turns were connected.

The following tests were taken on the static balancer:

Out of-Balance.	+ Volts.	—Volts.	Difference.	Per Cent.	Per Cent Full Load of Balancer	Per Cent Full Load of Dynamo.
Amperes.			Volts.		Per Cent.	Per Cent.
10	257.0	258.0	1.0	0.2	6	—
43	257.0	258.5	1.5	0.3	25	6.1
60	257.0	259.0	2.0	0.4	35	8.5
80	256.6	259.0	2.5	0.5	47	11.4

From the foregoing tests it is reasonable to assume that the difference in the voltage across the middle and the outers would not exceed one per cent at the full load of the static balancer. The static balancer in the case mentioned has one-quarter of the capacity of the generator. If very heavy out-of-balance currents have to be dealt with, in proportion to the size of the static balancer and generator, then a middle

wire booster can be attached to the machine to boost the out-of-balance side (see Fig. 10), which illustrates a rotary converter installation on the low-tension side.

In the discussion that followed the reading of Mr. Cooper's paper, C. F. Smith, of the Manchester School of Technology, pointed out that in comparing the connection on static balancers with rotating balancers, it was sometimes forgotten that a static balancer has not the same functions as a motor-generator balancer. The former simply provides a return path for the out-of-balance, and it is compensated for in return.

S. J. Watson, borough electrical engineer, of Bury, considered that the best form of balancer for a power station was a battery divided into two parts across the three-wire system left continuously on the mains. He had got over the difficulty of balancing cinematographs by running a short middle wire direct from the generating station to which the services to the cinematographs were connected, so that the disturbance was entirely restricted to those users who actually cause the variation.

A Substantial Saving on Small Repairs.

It is probably a common custom for central stations throughout the country to install their equipment prior to furnishing service and also to make all incidental repairs necessary after inaugurating such service. In many instances, too, central stations maintain a construction department for general contracting and repairing.

On repair jobs where the amount of work involved is large the profits are correspondingly large and the work finished wtihout complaint. On small jobs, however, which frequently result in losses and in the majority of cases in extremely small if any profit, time is an important factor for two reasons. First, the more time consumed in making a repair the greater the expense and second it has been found true that when making repairs in residences the people are as a rule impatient to have the work finished and in many cases even necessary delays often cause dissatisfaction that is injurious to the central station.

The Commonwealth Edison Company, Chicago, Ill., until recently took the following course when called upon to make repairs: An order being received a foreman was sent out to investigate the nature of such repairs and the material necessary. He would then return to the store-room, and draw the material and send it out on a wagon. A repairman had in the meantime left for the designated place and it was often the case that a considerable time elapsed before the arrival of the material.

The conditions, however, have been greatly changed since the Commonwealth Edison has placed in operation an electric vehicle, which resembles a pie wagon in construction, and is fitted up as a miniature storeroom. A view of this conveyance is shown in the accompanying illustration. On either side of the center aisle are compartments which can accommodate enough material for the average number of repairs made in a day.

COMMONWEALTH EDISON COMPANY'S ELECTRIC REPAIR WAGON.

A foreman is placed in charge of this repair wagon and at each stop the necessary material is left for making the repairs. In this way all orders received on one day are taken care of the following day with a minimum loss of time.

The result of handling repairs in this manner has resulted in such a substantial saving on small repairs that the Commonwealth Edison Company has formulated plans to shortly place in operation several more of these so-called "pie-wagons."

UNIQUE AUTOMOBILE GARAGES.

BY A. H. SIKES.[1]

There are owned in the city of Rockford, Ill., approximately 140 electric automobiles, or three-and-one-half per thousand population.

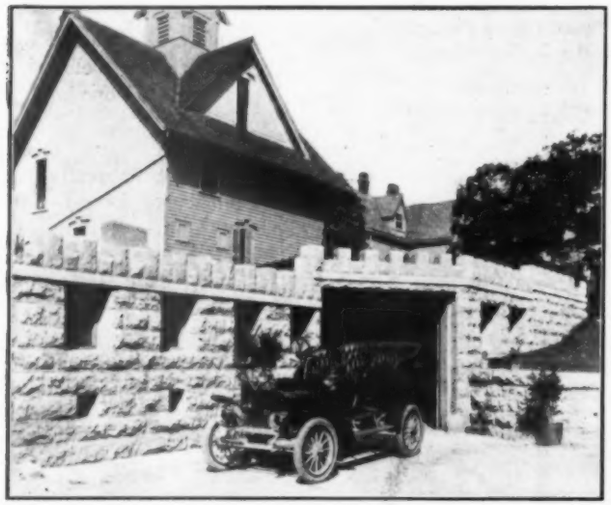
Among this large number of electric-car owners there are naturally many different types of garages, some of them very inexpensive and others constructed with little regard to cost. Many machines are occupying the stables of the horses they have superseded, much to the improvement in the appearance of the premises and the pleasure of the neighbors. One very common method on some of our streets where the slope of the ground necessitates a high porch is to lay a concrete floor underneath, and close up the sides and ends. This makes a very convenient and satisfactory garage and there being no inflambables used around electrics there is no fire risk.

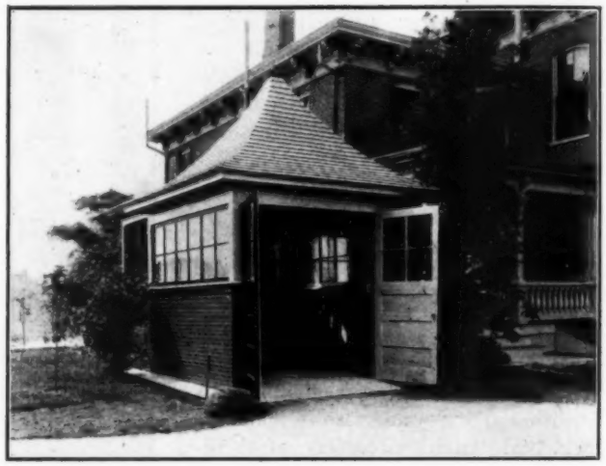
Rockford's finest garages have been constructed in the same type of architecture as the residence, some of them with cut stone walls and tile roofs. Concrete floors are used and the floors slope to the drainage outlet for convenience in washing the machines.

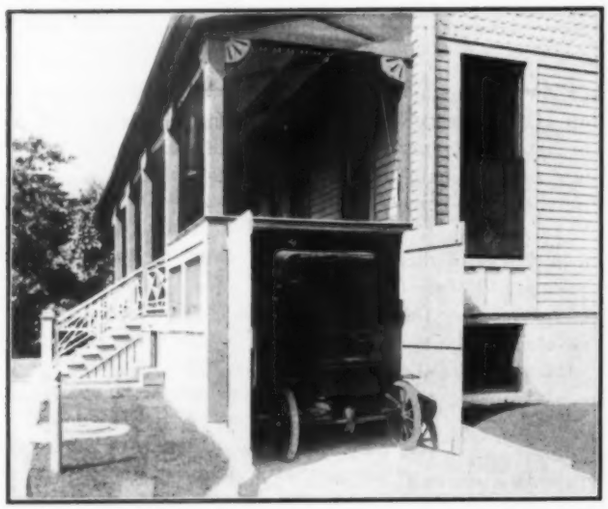
A garage can be heated easily by running a steam pipe from the house or by installing a small electric radiator. Where the electric radiator is

1 Manager New Business Department, Rockford Electric Company.

used we place it on the same rate we use for charging.







SOME UNIQUE ELECTRIC AUTOMOBILE GARAGES AT ROCKFORD, ILL.

The size of the building required depends upon the equipment of the car. Many of our users have an extra coupé body for winter use, and room must be provided for storing it in the summer time. A small work-bench and a cupboard for accessories is very convenient.

People who rent their homes and do not care to make a permanent investment on another man's property will find the portable garages advertised in magazines to be very satisfactory.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

SOME CHEMISTRY OF LIGHT.[1]

BY DR. W. R. WHITNEY.[2]

From the dawn of history, chemistry has had much to do with the production of artificial light, and I wish now to recall to your minds a few illustrations. It is supposed that the first lamps were made from the skulls of animals, in which oil was burned. Night was observed all over Egypt by the general lighting of lamps, and these lamps were probably the forerunners of the well-known Greek and Roman lamps of clay and of metal which are so common in our museums.

The candle and lamp were probably invented very much earlier. We know that both lamp and candles were used by the priests of the Jewish temple as early as 900 B. C. The fats and waxes first used were greasy and the light was smoky and dull.

The distillation of gas from coal or wood in 1739 was a chemical triumph, and a visit to a gas plant still forms one of the main attractions to the young chemist in an elementary course of applied chemistry.

Various schemes were devised in the early part of the nineteenth century for using gas to heat to incandescence, rods or surfaces of lime, zirconia and platinum. This was not at first very successful, owing to imperfect combustion of the gas. The discovery of the Bunsen-burner principle was made a little later. By thus giving a much higher temperature to the gas flame and insuring complete combustion, new impetus was given to this branch, and the development of suitably supported oxide mantles continued for half a century.

Most prominent in this field is the work of Auer von Welsbach. It was a wonderful series of experiments which put the group of rare earth oxides into practical use and started a line of investigation which is still going on. The Welsbach mantle practically substitutes for the carbon of the simple gas flame, another solid in a finely divided shape capable of giving more efficient light. This allows all of the carbon of the gas to contribute to the production of a hotter flame.

The methods of making the present mantles were also a part of Dr. Auer's contribution to the art. Suitably woven fabrics are dipped into solutiions of the rare earth salts; these are dried and the organic matter burned out, leaving a structure of the metal oxides.

The pure thoria gives a relatively poor light. The addition of the ceria, up to a certain amount, increases the light. This added component is called the "excitant," and as the cause for this beneficial action of the excitant is not known, it is possible that further discoveries along this line will yet be made.

There is hardly a prettier field for chemical speculation than is disclosed by the data on these light efficiencies. For some unknown reason, the change in composition by as little as one per cent varies the luminosity over tenfold, and yet more than one per cent of the excitant (ceria) reduces the light.

I will merely refer to the fact that vapors of gasoline, kerosene, alcohol, etc., are now also used in conjunction with the Welsbach mantles. The field of acetylene I must also omit with a mere reference to the fact that the manufacture of calcium carbide was a chemical discovery; and the action of water upon it, producing the brilliantly-burning acetylene gas, was another.

Turning now to electrical methods of generating light, we find the chemist early at work. Sir Humphrey Davy and others, at the dawn of the nineteenth century, showed the possibilities which since that time have been developed into our various types of incandescent and arc lamps. We naturally attach Mr. Edison's name to the development of the carbon incandescent lamp, because it was through his indefatigable efforts that a practical lamp and illuminating system were both developed.

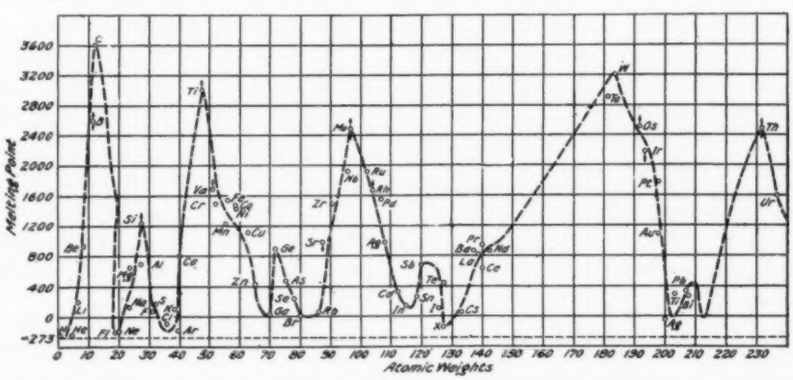


FIG. 1.

It had long been known that platinum, heated by the current, gave a fair light, but it melted too easily. A truly enormous amount of work was done in attempts to raise the melting point of the platinum, and the effect of occluded gases, of annealing, of crystalline condition, etc., were most carefully studied, but the results were unsatisfactory. He was therefore led to the element carbon as the next most promising conductor of high melting point. Edison's persistent and finally successful attempts to get a dense, strong, practical filament of pure carbon for his lamps, is one of the most encouraging lessons to the chemist of today.

1 Abstract of presidential address to the American Chemical Society, December 29, 1909.
2 Director of the research laboratory of the Schenectady Works of the General Electric Company.

From our point of view, all subsequent changes in choice of material for incandescent lamp filaments have been dictated by the knowledge that high melting point and low vapor tension were the first requirements. If you will consult the curve (Fig. 1) of the melting points of all the elements, as plotted against their atomic weights, you will see at once that the desired property of high melting point is a periodic function of the atomic weight. And it is this fact, which was independently disclosed as a general law by Meyer and Mendeleeff, in 1869, that has aided in the selection of all the new materials for this use. You will notice that the peaks of the curves are occupied by such elements as carbon, tantalum, tungsten, osmium, etc., which are all lamp materials.

A study of the laws of radiation also soon played a part in incandescent lamp work. The early rough and black filament of bamboo was first replaced by a polished black carbon filament, and later by one which had a bright, silver-gray coat of graphite. A black body at any temperature radiates the maximum possible energy in all wave-lengths. Heated to incandescence, it will radiate more invisible and useless infra-red rays than any other opaque material at the same temperature; a polished metal is therefore a more efficient light source than the same metal with a black, or even rough surface. This fact is derived from Kirchoff's law of radiation and absorption, which was early established.

With an incandescent lamp containing a platinum wire filament, the intensity of its light is not very great, even when the current is sufficient to melt the wire. A much greater luminosity is produced by a plain carbon filament, and a still greater by the graphite-coated and metallized carbon before they are destroyed. In the case of carbon, the useful life of the lamp depends much more on the vaporization of the material than on its melting point, and these lamps will operate for a short time at very much greater efficiencies or higher temperatures than is possible when a practical length of life is considered. Thus, besides the physical effect of surface quality, we have evidence of differences in the vapor pressure of different kinds of carbon. It looks as though carbonized organic matter yielded a carbon of much greater vapor pressure for given temperature than graphite, and that even graphite and metallized graphite are of quite distinctly different vapor pressures at high temperatures. It may be interesting to note here that if the carbon filament could withstand for 500 hours the maximum temperature which it withstands for a few moments, the cost of operating incandescent lamps could be reduced to nearly a fifth of the present cost.

It was discovered by Auer von Welsbach that the metal osmium could be made into a filament, though it could not be drawn as a wire. The osmium lamp was the first of the recent trio of metallic filament incandescent lamps. The tantalum lamp, in which another high melting point metal replaces the superior, but more expensive osmium, has been in use six or eight years. This surpasses the carbon in its action, and on running up to its melting point it shows still brighter light than carbon.

More recently the tungsten-filament lamp has started to displace both of the others. At present this is the element which withstands the highest temperature without melting or vaporizing, and on being forced to its highest efficiency in a lamp it reaches higher luminosity; it is similar to carbon and tantalum in that an enormously greater efficiency may be produced for a very short time than can be utilized for a suitable length of life. The inherent changes at these temperatures, distillation or whatever they are, quickly destroy the lamp. The lamp will burn an appreciable time at an efficiency fifteen times as great as that of the common operating carbon incandescent lamp (at three watts per candle). In other words, light may be produced for a short time at an energy-cost one-fifteenth of common practice, so that there is still a great field for further investigation directed towards merely making stationary those changing conditions which exist in the burning lamp.

While it is generally true that the light given by a heated body increases very rapidly with the rise of temperature above 600 degrees, the regularity of the phenomenon is commonly overestimated. A certain simple law covering the relation between the temperature and the light emitted, has been found to apply to what we call a black body. This so-called Stefan-Boltzmann law states that "the total intensity of emission of a black body is proportional to the fourth power of the absolute temperature." There are, however, very few really black bodies in the sense of the law. The total emission from a hole in the wall of a heated sphere has been shown experimentally to follow the law rigidly, but most actual forms and sources of illumination do not. Most practical sources of artificial light are more efficient light produers than the simple law requires. This may be said to be due to the fact that these substances have characteristic powers of emitting relatively more useful energy as light than energy of longer wave-length (or heat rays). Most substances show a power of selective emission and we might say that an untried substance, heated to a temperature where it should be luminous, could exhibit almost any conceivable light effect. A simple illustration will serve to make this clear: If a piece of glass be heated to 600°, it does not emit light; if some powder such as clay be sprinkled upon it, light is emitted, and the proportion of light at the same temperature will depend upon the composition of the powder. Coblentz has shown, both for the Auer mantle and for the Nernst glower, that the emission spectra are really series emission bands in that portion of the energy curve which represents the larger part of the emitted energy. This is in the invisible infra-red part, and so the laws which govern the emission at a given temperature depend upon the chemical composition of the radiant source. Silicates, oxides, etc., show characteristic emission bands.

One of the most attractive fields of artificial light production has long been that of luminous gases or vapors. It has seemed as though this ought to be a most satisfactory method. The so-called Geissler tubes in which light is produced by the electrical discharge through gases at low pressure are familiar to all. The distribution of the energy emitted from gases is still further removed than that of solids from the laws of a black body, and a large proportion of the total electrical energy supplied to a rarefied gas may be emitted as lines and bands which are within the range of the visible spectrum. These lines, under definite conditions of pressure, etc., are characteristic of the different elements and compounds. The best known attempts to utilize this principle are the Moore system of lighting (in which long tubes

of luminous gas are employed), and the mercury lamps, which, while more flexible on account of size, are still objectionable because of the color of the light.

It is rather interesting that the efficiencies of all of these various sources of electric light are not nearly so widely different as one would expect from a consideration of the widely divergent methods of light production employed.

From the light of a vapor or gas to that of an open arc is not a wide step, but the conditions in the arc are apparently quite complex and there is a great deal of room for interesting speculation in the phenomena of an arc. Briefly, there are two kinds of arcs to

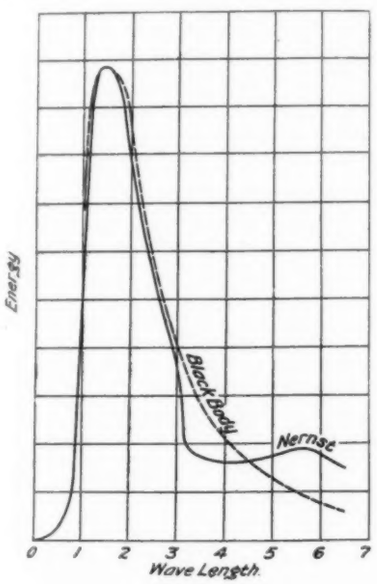


FIG. 2.

be considered in lighting. One has been in use for a century, the other for a few years only. The first is the successor to Sir Humphrey Davy's historical arc between charcoal points. In this kind of arc the current path itself is hardly luminous, and the light of the lamp is that given by the heated electrodes. In case of direct current it is the anode, or positive electrode, which gets the hotter and gives far the greater part of the light. In this carbon arc, it can readily be seen that the light is emitted by the heated solid carbon of one electrode; this gives a steady source of light, but is not so efficient as an arc in which material in the arc stream itself is the source of light. The arc may be made to play upon rare earth oxides, and these, being heated to incandescence, increase the luminosity, but this has not proved useful. The more common way is to introduce into the carbon electrode certain salts which volatize into the arc and give a luminous effect. Here cerium fluoride, calcium fluoride, etc., are used, and the color of the arc, just as in the case of gas mantles, may be varied by varying the composition of the electrodes. This is seen in the arc from the carbon electrodes containing such salts.

In the case of the flaming arc, the greater part of the light is due to the incandescent metallic vapors in the space between the electrodes. Substitution of one chemical for another in such flaming arc electrodes has covered quite a wide range of chemical investigation. Salts are chosen which give the greatest luminosity without causing the formation of too much ash or slag. Some compounds of calcium, for example, are practicable, while others are not, though all of these would, under suitable conditions, yield the calcium spectrum. If such salts as calcium fluoride were conductors at ordinary temperature, useful electrodes for flame arcs would probably be made from them. Such conducting materials as iron oxide, carbides, etc., have been used for flame arc electrodes, and a great many of the so-called magnetite arcs are now in use. The electrodes in this case are largely magnetic oxide of iron, with such other ingredients as titanium and chromium oxides, to increase the intensity of light, to raise the melting point of the mixture, etc.

As will be seen from observing this arc, the light is very white and intense and is generated by the heated vapors of the arc proper. A great many modifications of this arc principle are possible. Titanium carbide and similar substances give characteristic arcs, and some of them are very intense and efficient.

A distinct species of electric incandescent lamp is that invented about ten years ago by the well-known physical chemist, Professor Nernst. This employs for filaments a class of bodies which are not electrical conductors at all at ordinary temperatures, and which, at their burning temperatures, do not conduct the current as metals and carbon, but as a solution does. This kind of conductivity, the electrolytic, involves electrochemical decomposition at the electrodes, and in the case of the Nernst filaments these otherwise destructive reactions are rendered harmless by the continual oxidizing action of the air. For this reason this type of lamp will not burn in vacuo.

For its most perfect utility the principle of the Nernst lamp seems to require a mixture of oxides, because a single one is not so good a conductor nor so luminous. It uses oxides because these are the most stable compounds known, and it uses the rare earth oxides because they have higher melting point than other oxides. As the efficiency rises very rapidly with temperature there is a great advantage in using the most infusible base possible. For that reason, zirconia, thoria, etc., are usually employed.

In this lamp a rod or filament of an oxide mixture, much like those used in Welsbach mantles, is heated by the current, externally applied, until it reaches

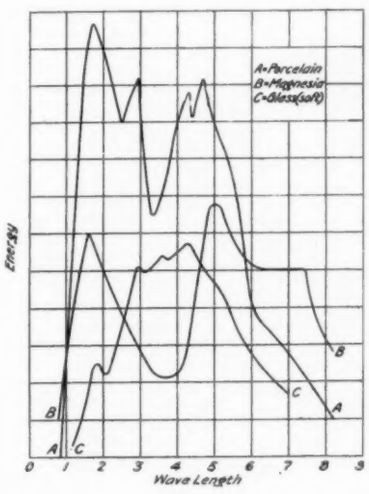


FIG. 3.

a temperature at which it becomes a good conductor itself. Here again the peculiar laws of light emitted at a given temperature being determined by the nature of the substance, Just as the pure thoria gives a poor light compared to the mixture with one per cent ceria, so a pure zirconia rod, heated by the current, gives much less light than a rod containing a little thoria, ceria or similar oxide. Work done by Coblentz on the energy emission of such rods shows the emission spectra, at least in the infa-red, to vary with the nature of the substance. In general, the spectra are not continuous like the spectra of metals and black bodies, but seem to occupy an intermediate position between these and luminous gases, which we know have usually distinct line spectra.

This recalls the subject of selective

emission. Coblentz has shown selective emission in the long wave-lengths for a Nernst glower. This is shown in comparison with the emission of a black body, in curve No. 2. The two sources when compared at the temperatures where they exhibit the same wave-length for maximum emission, differ very considerably in emission in the infra-red, the black body giving more energy at the blue end, and less at the red end of the spectrum.

This is still more noticeable in the

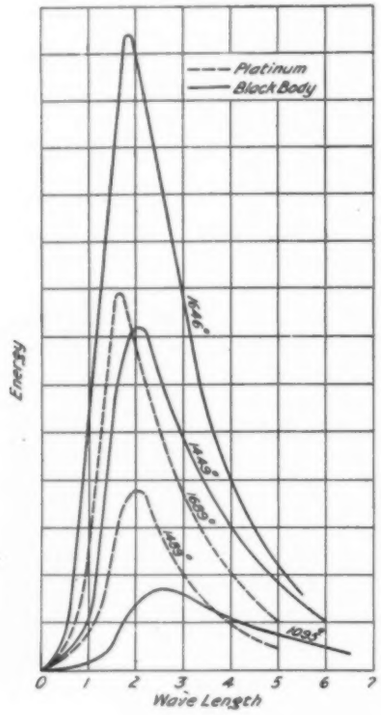


FIG. 4.

curves for such substances as porcelain, magnesia and glass, as shown by Coblentz's curves (Fig. 3).

The curves of wave-length and radiant energy which are shown are, with slight modifications, taken from work of Lummer and Pringshein and of Dr. Coblentz. The curve for the ideal, or black body radiator, gives a picture of the total energy and its distribution over the different wave-lengths. It is the peculiarity of the black body to radiate more energy of any given wave-length than does any other body at the same temperature. Therefore, in case of all substances acting as thermal radiators, the black body will always give the greatest brilliancy. Since this body at the same time radiates a maximum in all wave-lengths, it will be surpassed in light efficiency by any substance which is a relatively poor radiator in the invisible or non-luminous part of the spectrum.

In the energy curves shown it is to be noticed that the visible part of the energy is practically only that between 0.4 and 0.8 thousandths of a millimeter. Consider the solid lines in Fig. 4 for a moment. These show the emission of a black body at centigrade temperatures noted on the curves. Evidently the energy emitted rises very rapidly with the temperature; *i. e.*, as the fourth power of the absolute temperature. It will be noted also that the point of maximum energy or wave-length corresponding to maximum energy, shifts gradually towards the left, or towards the visible wave-lengths.

It is this rapid shifting of the position of maximum energy which makes the search for substances which can withstand even only slightly higher temperatures of such great interest.

The curves for the black body and for platinum (dotted lines) are not greatly different in general appearance, but the total amount of energy emitted at a given temperature from the black body is shown to be more than for the platinum, and it can be seen that at about the same temperature the platinum is the more economical light source. Professor Lummer has said that at red heat, bright platinum does not radiate one-tenth the total energy which the ideal black body radiates at the same temperature, and at the highest temperature still less than one-half. The deviation of platinum from the black body law is a step in the direction of getting improved light efficiency without corresponding increase of temperature.

This method is practically without limit in its extension, for there seems to be no limit to the forms of energy curves which different substances may possess. The curves are apparently determined not only by physical state, but also by chemical composition of the emitting substance.

In the production of artificial light, the tendency will always be in the direction of increasing the practical efficiency; *i. e.*, reducing the cost of light. We have seen that there is still much room for this. In the case of the kerosene oil lamp we know that much less than one per cent of the energy of combustion of the oil is radiated as light from the flame. In the case of the most efficient source—the electric incandescent lamp at highest efficiency—we are still far from ideal efficiency. A still higher temperature would yield a yet higher efficiency. We do not know exactly how much light might possibly be yielded for a given consumption of energy, but one experimenter concludes that it is about ten candles per watt. Fortunately, it is not now clear just how the chemist is to realize all the advances which he will make in more efficient lights.

No consideration of this part of the subject is complete without a brief reference to the efficiency of the firefly. The source of his illumination is evidently chemical.

The light-giving reaction is made to cease by the removal of the air, and to increase in intensity by presence of pure oxygen. It is extinguished in irrespirable gases, but persists in air some time after the death of the insect. Its production is accompanied by the formation of carbon dioxide. These all indicate a chemical combustion process. Professor Langley has shown that such a flame as the candle produces several hundred times as much useless heat as the total radiation of the firefly for

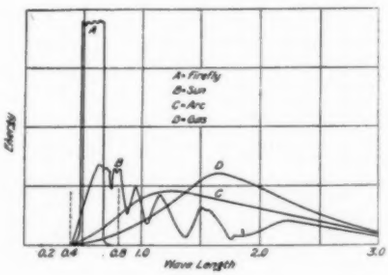
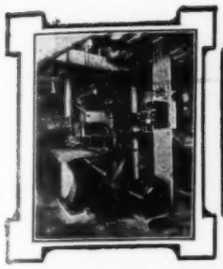
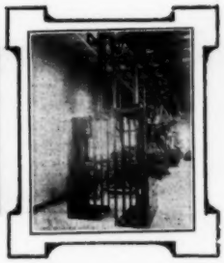


FIG. 5.

equal luminosity. In other words, the firefly is the most efficient light source known. This is illustrated by the energy distribution curves from several light sources taken from Professor Langley's work (Fig. 5). The difficulties attendant upon the accurate determination of the curve for the firefly are so great that we ought not to expect very great accuracy in this case. These curves, which in each case refer to the energy after passing through glass, which cuts off energy of long wave-lengths, represent the same quantities of radiant energy. While the sun is much more efficient than the gas flame or carbon arc, it still presents far the largest part of its energy in the invisible long wave-lengths (above 0.8), while the firefly seems to have its radiant energy confined to a narrow part of the visible spectrum.



Industrial Power



ELECTRIC DRIVE IN TEXTILE MILLS.

A DESCRIPTION OF THE INSTALLATION IN AN ENGLISH COTTON MILL, AND SOME VIEWS ON THE SUBJECT OF ELECTRIC DRIVE BY AN ENGLISH ENGINEER.

In an age of rapid progress, the most important industrial changes sometimes pass unnoticed except by those vitally interested in them. An instance in point is the application of electric driving in the cotton mill.

Probably few manufacturers are so well acquainted with the details of their business in all its branches as the Lancashire (England) cotton-mill owners, and the pre-eminence which Lancashire has won in this industry is as much due to this fact as to the suitability of the climate for manufacturing this class of goods. The question as to whether the adoption of electrical transmission would effect an economy which would not be more than counterbalanced by the losses in the conversion from mechanical to electrical energy, has been made by them the subject not only of the most animated discussion but of practical test.

As has happened in so many other cases, the new method, when tried, brought to light new elements of more importance than a slight increase or decrease in coal consumption. Recent instances of the adoption of electric driving in cotton mills, several of which might be named, show that the increased evenness of drive and uniformity of speed obtainable have not only resulted in an improved quality of yarn, but, by reducing the percentage of broken threads, have enabled both driving speeds and output to be materially increased.

But the adoption of electric driving brings other incidental advantages and conveniences. The cost of maintenance is less. A shut-down cannot take place which affects more than a small portion of the mill. Vibration is reduced. In the case of new mills, buildings are lighter in construction. Where a supply of power is available from an outside source, the capital expenditure on power plant is reduced, and the money thereby saved may be usefully spent on productive machinery.

A good example of a modern electrically driven mill is the Premier Mill, Stalybridge, England. This mill is situated in the Tame Valley, and may justly lay claim, in more respects than one, to the name it bears.

The mill is probably unique in that it is built entirely on the shed principle, there being no upper stories. The result is that the raw cotton, as it passes through the various processes, is readily handled until it leaves the mill in the form of finished cloth. Such an arrangement is only possible by the use of the electric drive; and as to the way in which it is accomplished the accompanying illustrations give an idea. Special attention is drawn to the absence of heavy drives as well as the brightness and businesslike appearance of the mill, and the fact that no floor space whatever is occupied by the driving machinery, the motors being all placed in out-of-the-way but readily accessible positions. The steadiness of these drives will be appreciated when it is pointed out that the photographs which yielded these illustrations were taken while the mill was running on load.

Three-phase current is furnished direct from the Stalybridge, Hyde, Mossley and Dukinfield Joint Boards' main generating station, being transmitted at a pressure of 6,000 volts to the mill, where it is reduced by means of three 250-kilowatt Westinghouse transformers to 400 volts, and distributed to the motors in the mill at this pressure.

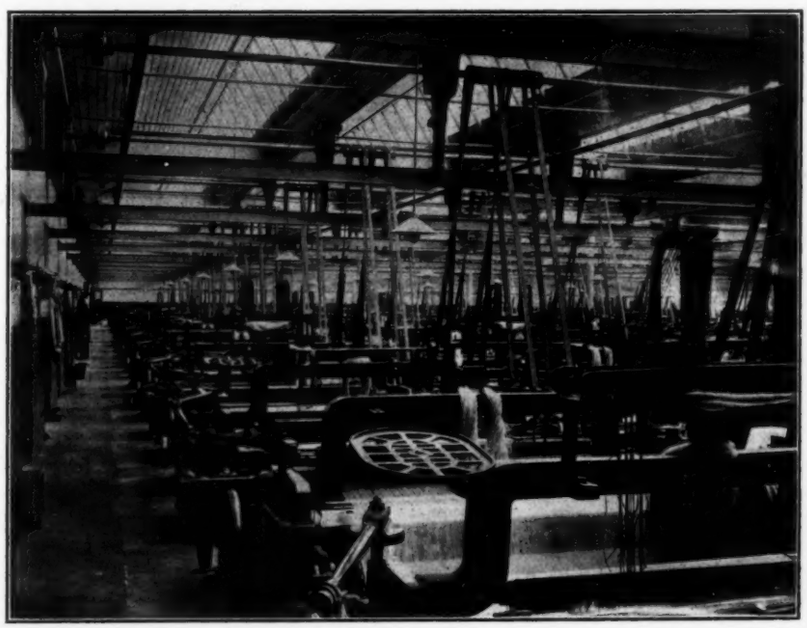


FIG. 1.—GENERAL VIEW OF WEAVING SHED.—MOTORS FOR LINE SHAFTS ARE OUTSIDE THE WALL TO THE LEFT.

The motors are of the induction type, and, wherever the conditions permit, a squirrel-cage rotor is employed. This is the case in all instances except the two 150-horsepower motors operating ring spinning frames, and the eighty-horsepower machine driving the slubbing and roving frames which are of the slip-ring type. The squirrel-cage rotor

has the great advantage that there are no rubbing contacts of any kind between the rotor and stator, whereas, with the slip-ring style, current has to be collected from the rotating part by means of brushes bearing on rings, these brushes and rings being entirely enclosed, as shown on the motor, Fig. 2; while Fig. 3 shows a similar machine but with the cover removed; under this machine (Fig. 3), is shown a view of the main switchboard, the original photograph having been taken from the other side of a window frame.

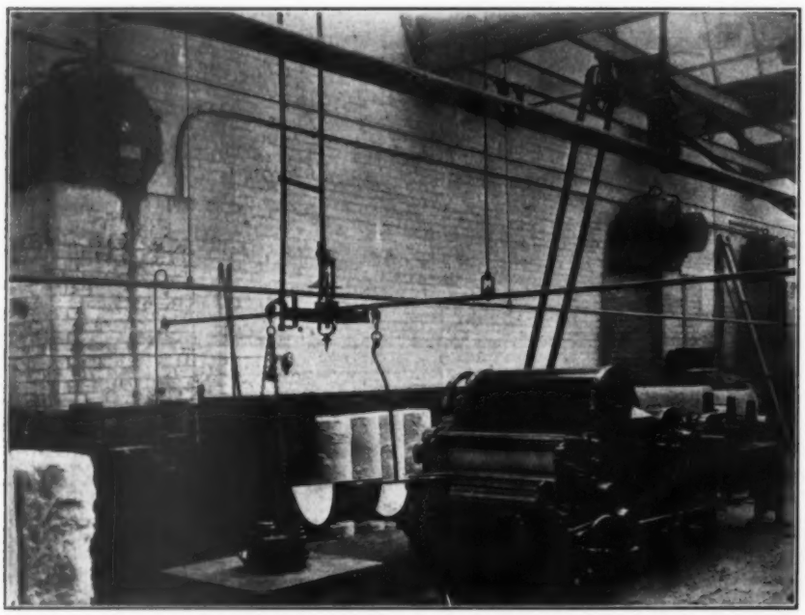


FIG. 2.—PICKER DRIVE FROM LINE SHAFT.—METHOD OF CONNECTING MOTORS IN ADJACENT ROOMS SHOWN BY MOTORS ON WALL DRIVING SHAFTS IN NEXT ROOM.

Fig. 2 shows a portion of the blowing room. The forty-horsepower squirrel-cage machine, seen at the extreme right, drives the machinery in this room as well as the bale breaker and lattice which are in an adjacent room. The slip-ring motor (eighty horsepower) is direct-connected to the line shaft, running at 580 revolutions a minute, seen in Fig. 4, from which the slubbing and roving frames are driven by means of half-cross belts, the high-speed shafting permitting the use of pulleys of approximately the same diameter on the shaft and frame, with the result that an excellent drive is obtained.

The carding machines and drawing frames, seen in the illustration last mentioned, are driven, in a somewhat similar manner, from the sixty-horsepower squirrel-cage motor shown in Fig. 2 at the left.

The ring room is operated by two 150-horsepower slip-ring motors running at 570 revolutions a minute and direct-connected to the line shafts. One of these motors with the slip-ring cover removed is shown in Fig. 3.

The general view of the weaving shed, Fig. 1, clearly shows the convenience and flexibility obtained by means of the electric drive. Any section of the shop can be run independently, which means a considerable saving at such times as the whole system is not required to be in operation.

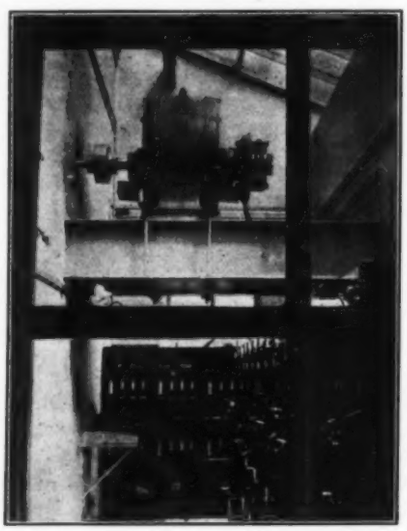


FIG. 3.—150-HORSEPOWER, SLIP-RING MOTOR, DIRECT-CONNECTED TO LINE SHAFT FOR RING-SPINNING ROOM.—ALSO MAIN SWITCHBOARD.

The motors for the weaving shed are outside the left-hand wall. Direct connection to the cross-shafts is adopted, and as the motors run at 750 revolutions a minute, quite small pulleys are required on the shafts to get the desired speed on the driving pulley of the looms.

Fig. 8 shows the motor alley, the motors being carried on girders from side to side as seen in Fig. 7, which is a view taken below the machines. It will be noticed that this alley constitutes the main passage in the mill, and, consequently, no otherwise useful space is occupied by the motors. This figure also shows the overhead railway for carrying the warp beams from the preparing side to the weaving shed. The motors driving the shaft comprise nine sixty-horsepower squirrel-cage machines, each direct-connected to one cross-shaft, as already stated, on which is carried a rope pulley which drives two other cross-shafts at the same speed, one to the right and one to the left.

FIG. 4.—SLUBBING AND ROVING FRAMES, DRIVEN BY WESTINGHOUSE MOTOR.

In Figs. 5 and 6, the squirrel-cage motors are seen to be coupled to the shaft by reduction gear. This gear is entirely inclosed, thus eliminating any possibility of harm to the attendant.

The plant and specification to which the electrical equipment of this mill was carried out, as well as the execution of the whole work are due to Robert Blackmore, who is not only the consulting engineer to the Premier Mill Company, but also the chief engineer and manager of the Stalybridge, Hyde, Mossley and Dukinfield Joint Boards'

generating station. The mill is electrically lit throughout, this work having been carried out by E. M. Evans and Company, of Manchester.

L. E. Wilson & Company, of Manchester, England, carried out the wiring work in connection with the motors, the whole of which, with their starters,

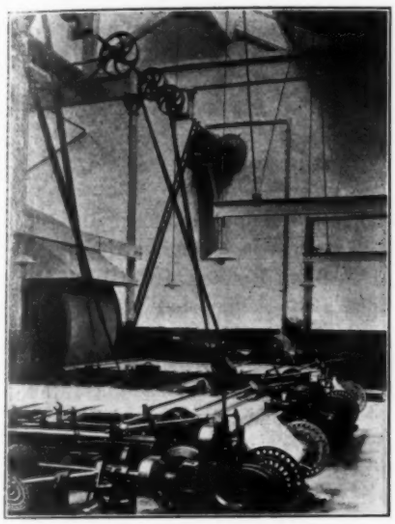


FIG. 5.—VIEW OF SIZING ROOM, SHOWING WESTINGHOUSE MOTOR GEARED TO SHAFT BY TOTALLY INCLOSED REDUCTION GEAR.

were supplied by the British Westinghouse Electric & Manufacturing Company, Limited, of London and Manchester.

In connection with the application of electric drive in textile mills in England, it is interesting to note that the British Westinghouse Company, of London and Manchester, England, has equipped the following mills with electric drive, the numbers in parenthesis denoting the total horsepower of the electric motors used in the respective mills: Albion Mills, Stalybridge (2500); T. Ashton Harrison & Company, Stalybridge (2100); J. M. S. Sharp, Low Moor (1500); Premier Mills, Stalybridge (1100); G. J. Stubley, Batley (600); Sir Titus Salt, Saltaire (475); Jeremiah Ambler & Sons, Bradford (250); J. Hoyle & Sons, Ramsbottom (350); William Rouse, Bradford (200); Alderman Horsfall, Keighley (200); Ingham Brothers, Halifax (200); Thomas Nuttall, Farnworth (200); Hugh Kershaw & Company, Mossley (175); Lister & Company, Bradford (150); E. Ripley & Son, Dyeworks, Bradford (150); E. Turner & Sons, Dyeworks, Halifax (150); Croft Mill, Mossley (120); Vulcan Spinning Company, Bury (110); Brunswick Spinning Company, Stalybridge (110); Clarke & Wilson, Mossley (100); Greetland Dye Works, Halifax (100); Crowther & Sons, Brighouse (100); John Crook & Company, Bolton (100); Geo. Knowles & Sons, Bolton (60); J. Briggs & Sons, Batley (50).

The above list, as the achievement of one prominent company alone, goes to show that the electrification of textile mills is no more in its experimental stages, even in conservative Lancashire. The advantages of this mode of power are gradually becoming more known and more firmly established.

The following article on electric drive in textile mills has been written, by request, by Mr. Preece, who is now acting as textile engineer to the British Westinghouse Company, and has taken an active part in the cotton-mill installations of that company. Mr. Preece has had twenty-four years experience in cotton-mill driving and lighting, out of which he spent twenty-two years as engineer at Lister & Company's mills at Bradford, which are reputed to be the largest in the world in the line of spinning silk and mohair, as well as in the manufacture of all kinds of pile fabrics and dress goods. Mr. Preece's views are as follows:

The adoption of the electric drive has many advantages compared with any other system of power transmission. In the first place may be mentioned the independent location of the power plant; without any regard to the mill buildings this may be placed

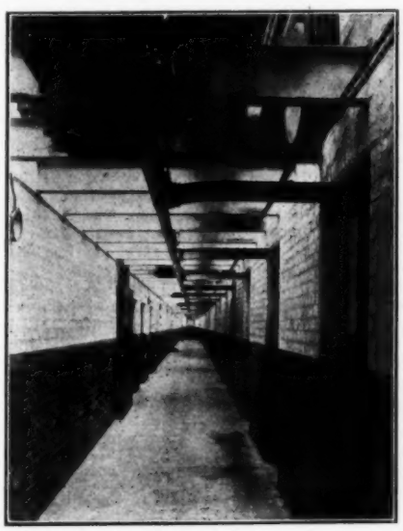


FIG. 7.—MAIN PASSAGEWAY.

in its most convenient position, the power being readily distributed to the various motors by the installation of the necessary cables, which can be easily erected, as it is not required that they should follow any predetermined direction or any definite position.

The location of a motor at the most convenient point for operating a section of machines, rooms, or floors, reduces to a minimum the number of belts, ropes, shafts, gears and other objectionable power-transmitting devices which are common to the mechanical drive. Additions to the mill may be made regardless of existing arrangements other than additional motors and generating plant. Each section, or part of a section, can be independently operated if the

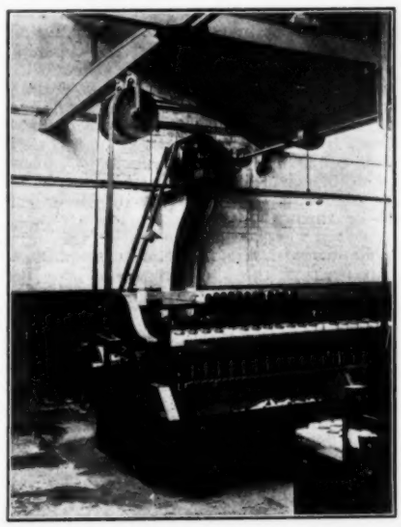


FIG. 6.—SPOOLER, SHOWING MOTOR GEARED TO LINE SHAFT FROM WHICH SPOOLER IS DRIVEN BY A QUARTER-TURN BELT WITH TWO IDLERS.

production gets out of balance, or, in the case of slackness of trade, a part of each process may be kept in full operation, the power used being in proportion to the number of machines running.

Records may be kept of the power used for operating the various sections, and any deviation from the normal will be immediately indicated, thus showing the necessity for an investigation into the cause.

System.—Until recent years it was the practice to install the direct-current system for power work, chiefly on account of it having been already adopted for lighting purposes at a time when the question of electric driving of textile mills was looked upon as an experiment. Now, however, since the introduction of the three-phase alternating-current induction motor, or what is commonly known as the squirrel-cage motor (on account of the rotating element being composed of solid copper bars placed in slots around the periphery of iron core), the troubles usually associated with the direct-current motor are entirely eliminated. There are no sliding contacts whatever, the only parts subject to wear being the two bearings, and no risk of fire need be anticipated. This type of motor can be connected in the center of the line shafts instead of at the end, thus reducing the torsional effects in the shafting.

Reliability.—The squirrel-cage motor may be considered thoroughly reliable on account of its extreme simplicity, and on this account it is largely used for operating machinery in the open, cutting and hauling mines, operating cranes in dockyards, in fact, doing work under the severest conditions that it is possible to impose upon it. Surely, therefore, the textile manufacturer need require no further evidence as regards reliability, as the textile industry does not, apart from dyeing and bleaching, impose any of these extremes.

Steady Turning.—Steady turning is un-

doubtedly one of the most important features in connection with a textile mill, and upon this depends the quality and quantity of the production. There need be no doubt, therefore, as to what is the best system to employ in order to ensure the best results. As the majority of textile machines are required to run at a constant speed, the three-phase system affords just what is required in this connection, providing that the supply of current is steady. This, of course, will depend on the prime mover.

Individual Drive.—Considerable differences of opinion exist in regard to the operation of textile machines with individual motor. Nevertheless this system has met with much success, more particularly in operating high-speed machines, such as rovers and ring frames. Looms may be successfully driven by this means, the motor being either coupled direct to the loom by means of suitable reduction gear and arranged to start and stop every time the loom is put into or thrown out of action, or arranged to operate the loom by means of a belt in connection with the fast and loose pulleys, as at present, the speed reducing gear being placed either on the motor or on the loom, whichever may be most convenient.

FIG. 8.—MOTOR ALLEY, SHOWING MEANS OF ACCESS TO THE MOTORS.

The chief objection to individual driving is owing to its high initial cost as compared with that of the group system.

Group Drive.—The grouping of a number of machines to a shaft operated with one motor has many advantages, the chief advantage being the lower first cost when compared with individual driving.

It has been the practice in the past to install motors of large size, owing to a desire to keep the initial cost of installation as low as possible. Now, however, since electric driving has made such headway in the textile field, it is desirable if we are to secure the best results to select sizes that will enable us to use as short lengths of shafting as possible, or in other words, to subdivide each process as far as possible or convenient.

The primary reason for the high speed of motors is a desire to keep down the cost by having a machine of small dimensions and whenever possible to couple it direct to the shaft, a method largely dependent on the speed of the shaft and the power it has to transmit. One instance known to the author is that of the Saltaire Mills, where three shafts are in operation, each transmitting 150 horsepower at 900 revolutions per minute, and there appears to be no reason why high-speed shafting should not be the rule for operating spinning machinery, as the higher speed permits of lighter shafts and smaller pulleys being used.

Mechanical Drive.—Textile mills, in the past have been designed to meet the conditions imposed by the mechanical drive. The usual custom was to place the engine inside the mill, the power being transmitted to the various floors by means of an upright shaft, the main line shaft being driven with spur and bevel gears. Apart from the noise, which in some instances is almost unbearable to the ordinary individual, it has the serious drawback of producing cyclic irregularities largely due to backlash in the gears, and further, the shafting being operated at the end similarly produces the irregularities due to torsion. This also applies to mills operated with the more modern method of rope driving. Consequently this irregularity in the turning moment of the shafting seriously effects the quality of the production.

Moscrop Recorder.—It is usual to take the engine records as a true indication of the general turning of the mill, but unfortunately this method does not record the turning at the machines. If, instead of the Moscrop Recorder being kept permanently coupled to the engine shaft, it is used for recording the turning of the shafts in the various rooms, irregularities due to the defective power transmitting device would be recorded, and by this means the manufacturer would often discover a fruitful source of trouble which gives rise to defective production. An excellent instrument for recording cyclic irregularity is the Horn portable tachograph. Shafting operating mules is generally affected the most on account of the variable nature of the load, and to the fact of the power being transmitted from one end of the shaft. The torsion effect becomes more acute at each stage where power is taken off to the various machines, and it is in cases of this kind that the electric drive proves its superiority over the mechanical method. The fact of coupling a motor in the center of short lengths of shafting entirely eliminates turning defects due to torsion.

For the driving of mules, the group system has so far given the best results, but satisfactory turning can be obtained with a motor driving a single mule if a suitable flywheel is used. Ring doublers and ring spinning frames can be successfully driven in groups from a high-speed shaft placed over the driving end of the machine using half-cross belts.

Manufacturers have become used to certain shaft and pulley speeds, so that it becomes a difficult problem when suggesting something out of the ordinary to convince them of its superiority. The result is that in several installations a considerably higher efficiency could have been obtained if, when the change to electric driving was made, a little more consideration had been given to the question of higher shaft speed. Very great care, therefore, should be exercised if the best results are to be obtained. The fact that it is almost as inadmissible to install motors too large as too small, calls for an investigation of the power required to operate each kind of machine, taking into account the extra power required after a weekend stop, which in many cases amounts to as much as twenty per cent in excess of the normal running conditions.

It is also necessary to take into account the class of material which is to be manufactured, and also the maximum temperature reached in each room.

"In the above review," writes an official of the British Westinghouse Company, "Mr. Preece refers to the question of individual drive for the spinning frame. The advantages of individual drive in the spinning room are now acknowledged on all sides, and in a short time a new feature will be introduced in this system which will make the electric drive an unqualified success in the spinning room. I am glad to inform your readers that India will not be left out from the advantages of this new system, and some very interesting experiments will shortly be carried out in the Bombay district under the supervision of the British Westinghouse Company with a variety of motors in order to establish the relative merits of the various systems."

English Municipalities Take Up Electric Pumping.

The Town Council of Richmond-on-Thames, England, having decided to use electrically driven pumps at Petersham well, the local electric light and power company has made a rate of three and one-half cents a kilowatt-hour for current used for this purpose, with a minimum annual payment of $500. Considering the small size of the municipality, the price for current is exceedingly low, notwithstanding the steady nature of the load.

Another township to take up electric pumping is that of Watford, also near London. The current is to be used by the Water Committee and is to be supplied by the municipal electric plant. The price in this case is fixed at three cents a kilowatt-hour for current up to 60,000 kilowatt-hours a year, and two cents for current consumed in excess of that amount, with a minimum annual payment of $2,250.

A New Ozone Generator.

The ozone generator, recently placed on the market by an English firm, consists of a series of plates of which the two outside poles are made of very finely articulated meshes with a central plate between them. Through this series of plates an alternate current of high frequency is sent, by which ozone is formed which is mixed in the conduit pipes with a large volume of air propelled by a fan. The ozone is generated without sparking discharge of the current, producing pure ozone without admixture of nitrous oxide or other impurities.

A somewhat similar system of ozone generation has been used successfully in America for purifying the air in public rooms, etc.

ELECTRICALLY DRIVEN PUMPS.—XII.

ELECTRIC PUMPING AT MORGAN PARK, ILL.

The following figures have been abstracted from the annual report of the Village of Morgan Park, Illinois, dated April, 1909.

This suburb of Chicago was the first village to contract for power from the Chicago Drainage Canal development at Lockport, and with the change in its motive power from steam to electric, has recorded a saving of approximately one-half.

Machinery.—The steam and electric equipment consists of: One steam Rand air compressor of a capacity of 200 gallons per minute; one steel air receiver of a capacity of 160 cubic feet; one Smith Vale direct-acting steam pump of a capacity of one and two-thrids gallons per stroke; two 100-horsepower steam boilers; one 150-horsepower water heater; one Ingersoll-Rand pov er air compressor of a capacity of 360 gallons per minute; one double-acting Deane power pump of a capacity of 360 gallons per minute; two Westinghouse sixty-cycle alternating-current induction motors, one of 100 horsepower and one of 20 horsepower, each equipped with automatic starting regulator, switchboard equipment, and step-down transformers.

Condition.—All the property of the village pumping and lighting plant, consisting of buildings, wells, steam and electrical machinery, reservoir, tanks, etc., is in good condition. The estimated value of the plant is $35,000. There are employed at the power station three electrical engineers.

Operating Expense, 1909.—The pumping and lighting expense for the year ending April 20, 1909, was as follows:

Electrical Engineers	$2,580.00
Electric Current (Sanitary District)	3,520.68
Coal	453.51
Oil	43.98
Carbons	55.05
Supplies and repairs	262.30
	$6,915.52
Waterworks, nine months by steam, three months by electric power	$7,549.19
Street lighting, ten months actual, two months estimated	2,877.00
Add to water expense to make full steam year for comparing purposes	900.00
Add to lighting expense, cost of operating twenty lamps added during the year 1908, for comparing purposes	628.00
	$11,954.19

Operating Expense, 1908.—The operating expense for the year ending April 21, 1908, was as follows:

Comparative Cost of Steam and Electricity.

Estimated cost of full steam year to April 21, 1908	$11,954.19
Actual cost for full electric year to April 20, 1909	6,915.52
Total saving in one year by electric power	$ 5,038.67

Cost of Electrical Machinery.

New machinery and cost of same	$8,963.76
Received from the sale of old machinery displaced	2,934.62
Net cost of machinery changes (1907-8)	$6,029.14

Production.—There have been pumped during the year 87,00,000 gallons of water, or a daily average of 24,000 gallons. The maximum months were August and September, and the minimum February. In supplying this water, the air compressor is in service about a daily average of seventeen hours, while the direct-acting pump forcing the water into the mains is in constant service.

Change of Power.—In 1906, the village board decided to avail itself of the use of the electric power for operating its pumping and lighting plant, which was offered at cost by the trustees of the Chicago Sanitary District to those municipalities, within its district, that were taxed for the construction work of the sanitary canal. The board accordingly obtained estimates of cost of electrical machinery and demonstrated to its satisfaction that there was economy in electric power. They, therefore, made application to the Sanitary District trustees for 150 horsepower, or less, for which the village is to pay a basic price of $26.40 per horsepower per year, for twenty-four hours daily service, and interest on a percentage of transmission cost.

Operating Economy.—It is not generally known perhaps, that Morgan Park claims the credit for having signed the first contract made by the Chicago Sanitary District Trustees for electric power from the Drainage Canal. This, however, has become history. It will be seen by the figures given in this report that the annual operating expense of the pumping and lighting plant has been reduced nearly forty per cent by the application of electric power.

Electricity in Contracting.

Electrically operated dredges have been used so satisfactorily at placer mines and on small ditching operations that their adoption for heavy general contracting has been foreshadowed for some time, says the *Engineering Record.* It is not often, of course, that current for such floating equipment can be obtained at a low rate, but where it can the electrical dredge may prove profitable. This has been the experience of the Tacoma Dredging Company with a twenty-six-inch hydraulic dredge used extensively in opening channels and filling low lands in the Puget Sound district. The current is taken from one of the 60,000-volt, sixty-cycle, three-phase transmission lines of the Seattle-Tacoma Power Company and is stepped down to 2,300 volts at a temporary substation near the shore, along which a temporary pole line is constructed. A three-phase flexible cable carried on the pontoons of the discharge pipe transmits current from the pole line to the dredge.

An Electric Pumping Plant for Irrigation.

The state of Idaho has recently granted a permit to the Post Falls Irrigation Company to perpetually divert the waters of Hayden Lake for irrigation purposes. A complete double pumping plant, electrically equipped, consisting of two motors, two centrifugal pumps, with a capacity of 18,000 gallons a minute, will be installed to distribute the water. This plant will pump water through a forty-two-inch pipe line, underground, a distance of four miles, to a point where the water will be distributed by gravity over the tract which is to be put under cultivation.

Frequency Changers for the Canal Zone.

Two sets of frequency changers will be installed in the power house at Cristobal, in order that the current transmitted from the power plant at Gatun for lighting Colon and Cristobal may be changed from twenty-five to sixty cycles. Each set consists of a 6,600-volt, three-phase, twenty-five-cycle synchronous motor, operating a 200-kilowatt, 2,300-volt, three-phase, sixty-cycle generator.

Another Convert to Electric Drive.

The J. B. Marten Company, of Norwich, Conn., which specializes in the manufacture of velvets, has decided to replace its steam drive by electric drive. The electrical installation will include about 200 horsepower of electric motors.

TELEGRAPHY—TELEPHONY, and WIRELESS.

History and Development of the Bell Telephone System.

In the annual report to the stockholders of the American Telephone and Telegraph Company, an excerpt of which appeared in last week's issue, President Theodore N. Vail presents an interesting survey of the history and development of the telephone system. An abstract of this commentary follows:

The telephone was first introduced to the public in 1876, and put to the first practical or commercial use in 1877. During that year was organized the first "association" or "company" to hold the patents. The first companies to systematically exploit the business were formed in 1878, one for New England, and one for the rest of the United States and Canada. These two companies succeed to all the rights and property of the original association. The capital, $650,000, 6,500 shares at $100 par each, represented the patents, such rights and property as had resulted from the time and money expended up to the spring of 1878, and in addition $100,000 in cash.

Early in 1879, these two companies were consolidated into one company, the National Bell Telephone Company, the first company to attain any prominence.

The capital of this company was $850,000, 8,500 shares of $100 par value each; $650,000 in shares was given share for share for the stock of the two old companies and $200,000 in shares left in the treasury. The treasury stock was sold as the company required the money, for the best price obtainable. The $200,000 par yielded to the treasury $430,000 in cash, an average of $215 per share, the last 500 shares having been sold for $600 each.

The stock of this company was fairly well distributed among 338 holders, an average of about 25 shares each, twelve holding in lots of 200 shares or over an aggregate of 4,795 shares out of the 8,500 shares.

At the highest quotation the total market value of all the shares of the company would have been $8,500,000. According to the popular belief, over twelve of the original investors have been credited with realizing, if not more, at least as much as this.

No dividends were paid by this company.

The rapid increase in the business called for more capital. Early in 1880 the American Bell Telephone Company was organized and the business of the National Bell Telephone Company transferred to it. The shareholders of the National Bell Telephone Company were given for each share of their stock six shares of the new American Bell Telephone Company stock. Eight thousand five hundred shares of the treasury stock were at the same time sold at par.

At the close of 1880 there were 540 holders of the 59,500 shares, an average of 110 each. Twenty holders of 500 shares or over had in the aggregate 33,190 shares. This was the last year that a majority of the stock was closely held.

In 1881 the first dividend was paid.

The American Bell Telephone Company continued the business until 1899, during which time the capital stock had increased from $5,950,000 to $25,886,300. The $25,886,300 capital was held by 6,961 shareholders; 62,649 shares were held by sixty-one shareholders in blocks of 500 shares or over, while the balance, 196,214 shares, was held by 6,900 holders.

The increase in the stock had been sold for cash at various times, yielding the company more than enough in premiums above par to offset the shares that had been issued for patents, inventions and property of the National Bell Telephone Company.

When the American Bell Telephone Company transferred its business to the American Telephone and Telegraph Company there had been over $28,000,000 actual cash paid into the treasury of the company by shareholders as against $25,886,300 capital outstanding. During the time no stock dividend or dividend of surplus in cash to pay for stock issued was made.

The market price of the American Bell Telephone Company shares during the year ranged above $200 a share. The company was paying fifteen per cent dividends yearly.

The demands of the business required much larger capital than could be provided under the corporate powers of the American Bell Telephone Company. The American Telephone and Telegraph Company, a company organized to operate long-distance traffic, purchased the business in 1899. The consideration was cash, but in effect the shareholders of the American Bell Telephone Company received two shares of the American Telephone and Telegraph Company for each share held. The dividends were put on a seven and one-half per cent basis and were increased in 1906 to eight per cent, at which rate they still continue.

Since 1900 the stock of the American Telephone and Telegraph Company has been increased from time to time as the business called for money. At the close of 1909 there were in the hands of the public $256,475,300.

So much of this stock as was not sold to the shareholders at par was sold for cash at a premium, the highest at $152 per share, or was issued in exchange for the convertible bonds at about $134 per share. None of the stock has been issued as a dividend, nor have any cash dividends been declared to meet payments for stock issues.

At the close of 1909 the premiums thus received over the par of the outstanding share capital amounted to over $14,000,000.

The original owners and promoters of the telephone were first of all business promoters. Their idea was to develop the business on broad lines. Whatever reward they expected or received was the legitimate reward following a legitimate development of a substantial and beneficial business.

To develop the business to the best advantage all the best in the way of instrumentalities, apparatus and methods must be controlled. Apparatus and methods at the start were crude, but new instrumentalities and new methods were suggested from daily association, practice and study.

It was necessary to develop these, improve and reduce the useful to practice, and eliminate the worthless. For this purpose a staff of technical, electrical and mechanical operating experts must be gathered together and educated. To educate and assist these, to enable them to do intelligent work, avoid repetition and duplication, all that had gone before all that was being done here and elsewhere must be known. For this purpose a bureau of research and information was formed. Patent and legal experts must be employed and educated to secure the advantage of this work and study, as well as to furnish protection in the use of the patents.

A highly developed manufacturing organization under proper supervision and control was required to reduce to practical use these ideas and inventions, as well as to secure the standardization and uniformity of instruments and apparatus.

To ascertain which were the best of the methods being evolved in field practice, to educate the others in the use of them, to assist generally in the development, and to bring about standardization of operating practice and methods, a staff of traveling experts, observers and teachers was placed in the field.

It is necessary to the growing and constantly improving business that this work be continued. It is being done much more economically and far more effectively by this company than it could be done by the associated companies, and without expense to them except so far as it is covered by the miscalled "rental" of telephones.

The preliminary work was certainly difficult enough. Add to that the necessity of educating a doubting, hesitating public who looked on the invention as little better than a toy, and some idea of the task can be formed.

In the promotion and exploitation of the business two methods were possible.

One company covering the whole country. This would require a large executive and administrative staff in the field, and a large capital which, at the time, it was impossible to secure. Under this method, state organizations would also have been necessary to hold franchises.

The other way was to enlist a large number of individual workers, each with some capital, large faith and expectation, with great capacity for work, who would cover the field and develop the business.

To insure a common policy and central control, all licenses were issued for small units of territory under restricted terms, confining the business entirely within each territory. The parent company owned and furnished the telephones, had all reversionary interests or rights in the territory, and the right to connect the units with each other for the purpose of forming a universal intercommunicating telephone system. For this purpose the long-distance lines and other toll lines were built. Under these temporary licenses certain rentals, so-called, or royalties, were paid to the parent company for the use of the telephones and other inventions owned, and also as compensation for all the many other services rendered, as described above. When these licenses were made permanent and included all future as well as all existing inventions, and the right

to the business within the units of territory, the parent company retained an interest in the business which was represented by a stock interest in each company.

These licenses called for a continued certain percentage of the stock of the company, but this right was soon waived by the parent company.

Through purchases to defeat the attempts of hostile interests to get possession of some of our associated companies, through the necessity of financing the companies for the purpose of keeping up with the demands for development, and through the purchase of its pro-rata of new issues, the American Telephone and Telegraph Company acquired its large holdings.

The book valuation of the American Telephone and Telegraph Company's interests in the share capital of the associated operating companies December 31, 1909, was nearly $306,000,000; of this only $16,000,000 was received through contract or for licenses. The balance, $290,000,000 was obtained under precisely the same conditions that shares have been received by the other shareholders.

While the settlement with the Western Union Telegraph Company in 1879 removed

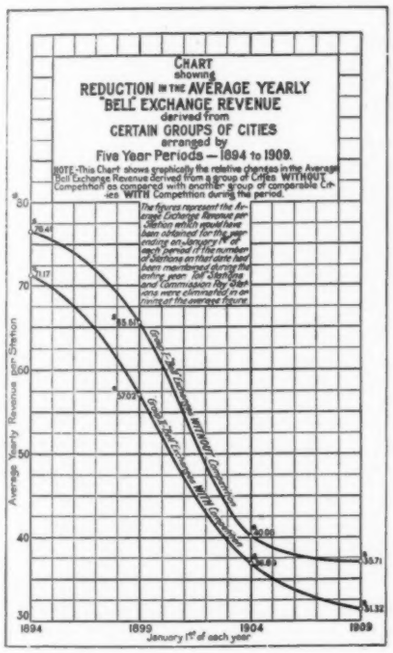


CHART
showing
REDUCTION IN THE AVERAGE YEARLY
BELL EXCHANGE REVENUE
derived from
CERTAIN GROUPS OF CITIES
arranged by
Five Year Periods — 1894 to 1909.
NOTE-This Chart shows graphically the relative changes in the Average Bell Exchange Revenue derived from a group of Cities WITHOUT Competition as compared with another group of comparable Cities WITH Competition during the period.
The figures represent the Average Exchange Revenue per Station which would have been obtained for the year ending at January 1st of each period if the number of Stations entered were had been maintained during the entire year, but Stations and Commission Paying Stations were eliminated in arriving at the average figure.
Average Yearly Revenue per Station
Group 2 "Competition without Competition"
Group 1 "Competition with Competition"
29.46
27.17
25.91
23.08
20.99
19.89
19.71
19.32
80
70
60
50
40
30
1894
1899
1904
1909
January 1st of each year

FIG. 1.

from the field the most formidable and powerful competitor, it must not be concluded that the American Bell Telephone Company had the field to itself. The Bell system did not then, nor did it in any year or any time since the great value of the telephone to the world was established, have a monopoly of the business or anything approaching it.

Patents and inventions were necessary for defense, but were no protection against imitators.

There was a continued running fight in the courts and in the field. The fact that the Bell won every case in the courts availed it nothing except that it was credited with a monopoly which did not exist.

The only time that the Bell Telephone was without a competitor was at the Centennial Exhibition of 1876.

COMPETITION.

There is not, nor can there be, any competition between these local associated operating companies, as under the conditions which they can use the instruments and inventions, they must operate entirely within their respective territories; nor can there be competition in the telephone exchange systems operating in the same territory such as exists between other public utilities, certainly not such as exists between two gas companies or even between a gas and an electric light company.

The telephone system does not give you a "commodity" or a "product," or even a "service" except so far as it is service to make up a "path" or "line" or "highway" for personal communication with a party at some distant point.

The value of a telephone system is measured by the possibility of reaching through its connections any one—at any possible place.

There can be said to be no limit to those with whom one may desire communication at some time or other. Ordinarily your communications are confined to a certain few other subscribers; occasionally you may wish to reach certain others, but there are times when it is an absolute necessity to get a connection with some one possibly unthought of or unknown before, and the importance of this connection may be vital.

A purely local exchange has a certain value.

If it has, in addition to its local connections, a connection with outlying contiguous localities, it has a largely increased value.

If it is universal in its connections and intercommunication, it is indispensable to all those whose social or business relations are more than purely local.

A telephone system which undertakes to meet the full requirements must cover with its exchanges and connecting lines the whole country. Any development which is comprehensive must cover some territory which is not, and may never become, profitable in itself but must be carried at the expense of the whole. It must be a system that will afford communication with any one that may possibly be wanted at any time. To do this the system must offer a connection of some kind, and at such rates, as will correspond to the value of the system to each and every user.

"Interdependence," "intercommunication," "universality" cannot be had with isolated systems under independent control, however well connected. They require the standardization of operating methods, plant facilities and equipment, and that complete harmony and co-operation of operating forces, that can only come through centralized or common control.

Wherever two systems exist, each has, with the exception of a percentage common to both, a different list of subscribers. Those of large and extended social or business connections must connect with both, while those who do not connect with both get only partial service—the same character of service offered by two street car lines, each having its tracks on and running through the principal main street of the town but each extending into and serving entirely different sections of the community.

Offering a connection with a so-called competing exchange, having a list of subscribers either entirely or largely different, is offering a different service, except so far as they connect the same subscribers, and there it is of no benefit, as either one would serve the purpose. Two exchanges, each with the same list of subscribers, cannot, in the nature of things, exist. One or the other would be unnecessary because a subscriber would be paying twice for the same service when either exchange gave all that could be obtained from both. It would be like paying two fares each time you ride in a street car to maintain a parallel line, although you could ride in but one at a time. Competition of that character increases the cost to you. Competition is only of service when it reduces your cost or increases your service.

ECONOMY OF COMPETITION.

By reason of duplications, duplication of investment, duplication of operation, competition in telphone systems cannot, in the nature of things, produce economy in operation, and without economy there can be no reduced charges.

With only one system, at once is eliminated the duplication of subscribers' lines—so also is eliminated the greater part of the unused and idle staff, equipment and plant, and with this are also eliminated capital investments, capital charges, operating salaries, plant maintenance and depreciation. That it contributes also to the comfort and convenience of the subscribers is in itself no small consideration.

WHAT HAS COMPETITION DONE FOR THE PUBLIC?

No one can dispute the fact that the Bell methods and system are the standard and have been accepted as the best the world over.

Telephone rates have fluctuated. Beginning with simple and crude instrumentalities and methods, with small developments, the rates were low. As facilities increased, as methods and apparatus improved, and apparatus almost new and hardly in use had

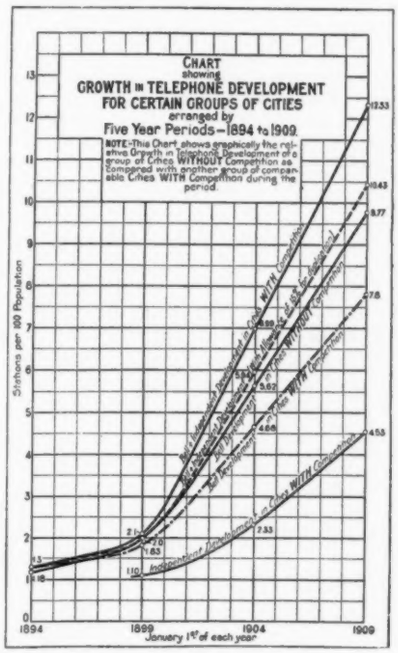


FIG. 2.

to be discarded to make place for new and improved methods, rates had to be increased.

In the New York City exchanges, apparatus and plant practically good as new to the value of over eight and one-half millions of dollars, have been discarded because new improvements had made them obsolete, nearly all between the years 1883 and 1902, and the same is relatively true of any exchange system. As methods, plant and apparatus became more fixed and permanent, methods of operating improved, operating expenses declined, and reductions in rates followed—not because of competition.

REDUCTION OF RATES AND DEVELOPMENT.

The diagrams (Fig. 1 and Fig 2) show the course of rates and development from 1894 to 1909, in the principal cities and exchanges with and without competition. The non-competitive cities and exchanges are about fifty per cent larger than the competitive.

The average revenue per exchange station in competitive and non-competitive Bell exchanges each year for this period is

shown in diagram (Fig. 1). The slightly higher average revenue in the non-competitive cities is due to their larger size.

The two curves showing the reduction follow almost exactly the same lines, and the percentage of reduction is almost the same.

Competition certainly had no effect on the Bell revenue, was of no benefit to the public, compelled all to pay two subscriptions instead of one for complete service, besides all the other disadvantages of dual exchange systems.

The development—that is, the number of exchange stations per 100 population—for Bell exchanges without competition and for Bell and opposition exchanges in cities with competition, is given in Fig. 2. The same cities are used as for Fig. 1.

The combined Bell and opposition development in the cities with competition in 1909, allowing fifteen per cent for duplication, was 10.43 per 100 population. The average duplication is probably nearer twenty per cent than fifteen per cent.

The Bell development in cities without competition was 9.77—only three-quarters of one station per 100 population less.

The Bell development alone in cities with competition is 7.8 per 100 population, or only 2.5 stations less than the combined development, as against the opposition development of 4.53 stations per 100.

The opposition figures are taken from opposition statements and include all the larger places where there were such exchanges and those of the largest development.

MINIMUM RATES.

For Bell exchanges aggregating some 700,000 stations with no opposition, the mean minimum rates for 1909 were $36 per year for business, and $23.75 for residence, as against the mean minimum rates in 1894 of $68.10 for business, and $56.00 for residence.

In cities with competition, where there were Bell exchanges aggregating 550,000 stations and opposition exchanges aggregating 322,000 stations, the mean minimum rates for Bell service were $41.25 for business, and $22.80 for residence; for the opposition service, the mean minimum rates were $37.15 for business, and $23.25 for residence.

AVERAGES OF OPERATING UNITS OF ASSOCIATED OPERATING COMPANIES, 1895 TO 1909.

The table herewith shows the averages of the revenue, expenses and other operating details of the associated companies for the years 1895, 1900, 1905 and 1909.

Taking the years 1895 and 1909, the average exchange revenue per station for exchange service was reduced from $70.00 to $31.50, or fifty-five per cent; the total revenue including toll revenue per exchange station reduced from $81.00 to $41.00, or one-half; the operating expenses including taxes reduced from $31.50 to $17.10, or forty-five per cent; maintenance per station reduced from $26.20 to $13.00, or one-half. Total operating expenses were reduced from $57.70 to $30.00 per station, or not quite one-half—that is, reduction of operating expenses of about one-half brought about a reduction in cost to the public of exchange service of over one-half.

The other figures show the various costs and expenses. The average plant cost, including toll and exchange construction, was reduced from $260 to $145 per exchange station, about forty-five per cent. All plant costs show a decrease per unit, although there has been an increase in both labor and material.

AVERAGES OF OPERATING UNITS OF ASSOCIATED OPERATING COMPANIES, 1905 TO 1909.

Average per Exchange Station.				
Earnings:	1895.	1900.	1905.	1909.
Exchange Service	$69.75	$44.68	$33.31	$31.37
Toll Servcie	11.35	12.60	9.95	9.42
Total	$81.10	$57.28	$43.26	$40.79
Expenses:				
Operation	$29.15	$21.63	$16.96	$15.14
Taxes	2.23	2.37	1.49	1.93
	$31.38	$24.00	$18.45	$17.07
Balance	$49.72	$33.28	$24.81	$23.72
Maintenance and Depreciation	26.20	17.68	13.91	12.93
Net Earnings	$23.52	$15.60	$10.90	$10.79
Per Cent. Tel. Exp. to Tel. Earnings.	71.0	72.8	74.8	73.6
Per Cent. Maint. and Depr'n to Aver. Plant, Supplies, etc.	9.1	8.4	8.9	8.4
Per Cent. Incr. Exchange Stations†.	15.7	26.5	24.5	11.6
Per Cent. Incr. Miles Exchange Wire†..	15.9	33.2	27.2	7.1
Per Cent. Incr. Miles Toll Wire†.....	21.3	25.2	12.4	4.4
Average Plant Cost per Exchange Station (including Exchange and Toll Construction)	$260.00	$199.00	$145.00	$145.00
Average Cost per Mile of Pole Line (Toll), including Wire	$219.00	$348.00	$438.00	$610.00
Average Cost per Mile of Wire (Toll), including Poles...	$81.00	$71.00	$62.00	$63.00
Per Cent. Gross Tel. Earnings to Average Constr.	33.4	31.7	31.7	29.6
Per Cent. Net Profits to Aver. Capital Stock	10.11	9.44	8.34	8.14
Per Cent. Dividends to Aver. Cap. St'k	5.07	6.19	5.75	5.95

†Increase during years shown, over previous year.

For Telephone Control.

The report of the special New York State legislative committee which investigated the question of placing telephone and telegraph companies under State supervision was transmitted to the Legislature on March 21. It recommends that the Public Service Commission for the Second district have supervision over telephone and telegraph companies as to rate, service and finances, so far as New York State is concerned.

Secondary recommendations are that the Second district commission have authority to hold hearings anywhere in the state; that it be permitted to establish a branch office in any first or second class city; that there be exempted from its jurisdiction any concerns like the "farmers' telephone companies" not conducting their business for profit, and that the commission in its discretion may have power to exempt any company from reporting to it.

A bill to carry out the recommendations of the committee will be prepared and introduced amending the Public Service Commissions law.

The *Electrical Review*, of London, England, is authority for the statement that the Turkish Government is reported to be considering the question of establishing a network of telephone lines extending from Constantinople to Jerusalem and Mecca.

Southwestern States to Be Linked Up by Telephone.

El Paso and all the tributary territory in southern New Mexico, western Arizona and northwest Texas will be in direct communication with Denver by telephone within a year, said E. B. Field, one of the incorporators of the Tri-State Telephone and Telegraph Company, which recently filed articles in the office of the secretary of state of Colorado.

The company is incorporated for $1,000,000, and the work of building the system will be started within six months.

The Colorado Telephone Company, under its charter, is authorized to do business only in Colorado and New Mexico, but the Tri-State will have the right to enter New Mexico, Texas and Arizona.

El Paso is the center of a large and growing country, for which it is the market, and by supplying telephone service it is believed the business of the section will be enlarged.

"The extension of our lines," said President Field, "will prove a great benefit to Denver and all of Colorado, because it will place this state in direct communication with a large territory in the Southwest. We have not fully surveyed the field, but I have a comprehensive plan of the system to be built. There will be no delay and I expect to have the work completed in a year."

More Farmers' Telephone Lines for Georgia.

At an enthusiastic meeting held recently at Tifton, Ga., a resolution was adopted pledging the support of the assemblage to co-operate with the Southern Bell Telephone and Telegraph Company in the establishment of farmers' telephone lines in Tift county, until every section of the county is reached. A committee was appointed to act in co-operation with the solicitors sent out by the Bell people, and a subscription list was started. The proposition is now well under way.

An English report states that the Hull Steam Fishing and Ice Company, which operates a fishing fleet in the North Sea, is equipping its vessels with wireless telegraph apparatus. The *St. Vincent* is the first fishing vessel on the North Sea grounds which has been provided with the wireless apparatus.

Telephone Traffic of the Commonwealth Edison Company.

The first private telephone exchange installed for use of the Commonwealth Edison Company, Chicago, Ill., was placed in service about April 1, 1893. This consisted of a one-position switchboard, equipped with one trunk line and eight terminals. The capacity of this board has gradually been increased, until today it consists of an eight-position board, with forty-six trunk lines and 250 terminals.

The last traffic record taken on the board showed a total of approximately 12,000 messages handled by the operators in a period of twenty-four hours. This is equivalent to an increase of eighty-two per cent in the volume of telephone business handled through the company's board in the last two years, and indicates a traffic of about 4,000,000 messages per annum. Thus it may be seen that the telephone occupies an extremely important position in the conduct of the company's affairs.

For the purpose of instructing its employes in the use of the telephone with the idea of characterizing its telephone service by unfailing promptness, courtesy and accuracy, the Commonwealth Edison Company has issued a booklet for their guidance, a few paragraphs of which are abstracted for these columns:

Courtesy is the outward expression of breeding and character. Its practice is founded upon the Golden Rule of "Doing unto others as you would they should do unto you." In very few industries is the need of courtesy more imperative than in ours; the business of manufacturing and supplying electric light and power is, to the layman, peculiarly technical and mysterious. He does not comprehend its complicated processes, and he resents its apparent mystery. In dealing with this type of man, who cannot understand why his service is not connected within twenty-four hours after signing an application, or why he should have to obtain city inspection on his power installation, our employes have daily opportunities for showing the quality of their courtesy. It is necessary for them to remember that the customer is unacquainted with many conditions with which they are thoroughly familiar, and in imparting this knowledge to the customer, they should not do so with any assumption of superiority, or any display of impatience. The favorable impression made upon a customer who takes up his telephone to register a vigorous complaint, and who finds a courteous employee at the other end of the wire quick to understand his difficulties and eager to remedy them, cannot be overestimated. From being one of its severest critics, the customer becomes one of the company's best friends; he is usually gratified to recognize the courtesy with which he has been treated, and does not hesitate to advise it amongst his friends.

After a call has been received on the telephone, and it is desired to signal our operator, care should be taken to flash slowly, as the signal lamps on the switchboard will not light up if the receiver hook is moved up and down rapidly. If, on an original call, or on a flash signal, the operator does not respond within a reasonable time, the matter should be at once reported over another telephone to the chief operator, who will thus have an opportunity to ascertain if the corresponding signal lamp on the switchboard is burned out.

Wireless Installation on a Pacific Mail Boat.

In sending the information that the Canadian-Australian steamer *Makura* has been equipped with wireless telegraphy, a consular report makes the following comment: The steamer was fitted in Vancouver by the United Wireless Service Company of the United States, whose head office is at Seattle, Wash. This company is said to be the largest on the Pacific, having 300 wireless stations in the United States and installations on 380 ships. By the *Makura's* wireless instrument messages are sent and received at a distance of 1,900 miles. On the *Makura's* last voyage to Sydney complete communication was kept up with Honolulu until the night before its arrival.

Telephone Courtesy for Company Employes.

In the course of a recent address to the employes of the New England Telephone and Telegraph Company. E. K. Hall, one of the attorneys for the company, gave some good advice on the necessity for forbearance and tact on the part of the company's employes in dealing with the telephone-using public. Particular instances touched upon included grievances arising from the trimming of trees, from disputed accounts, and from disconnection of the telephone for alleged nonpayment of dues in cases where the money had been paid and a mistake made by some department of the telephone company. In each case it was policy to use the utmost tact in dealing with dissatisfied customers, and it was often better to give in rather than cause any antagonism which might result eventually to the disadvantage of the company.

New York Telephone Bonds.

The subscription books for the $10,000,000 four and a half per cent first and general mortgage bonds of the New York Telephone Company, which were opened at 10 a. m. on March 16 last in this country and London, were closed promptly, the issue having been heavily oversubscribed.

Electrical Typewriting Telegraph for Berlin Police Department.

An electrical typewriting telegraph plant has been installed recently by C. Lorenz for the Berlin Police Department, says the London (Eng.) *Times*, and it forms the most extensive installation of its kind in Germany. The central station is located at the police headquarters, and about 200 receiving stations are distributed throughout the police area of Berlin and the immediate suburbs.

The plant is intended for the relief of the Morse telegraphs; it allows circular and other telegrams to be despatched more rapidly, and simplifies the whole operation. Any telegram despatched from the central station appears simultaneously in printed columns. An average of 150 telegrams are despatched daily from the central station, and as each telegram consists of about thirty words, this equals a daily work of 900,000 words, that is, 150 telegrams of an average of thirty words will be printed simultaneously each day on 200 receiving apparatus. On especially busy days this output is doubled.

The sending apparatus consists of a keyboard similar to that of a piano, and comprising a number of keys corresponding to the regular number of types in a typewriter. An experienced telegraphist is able to transmit about twenty-five words of five letters per minute with the apparatus.

Test Wireless Interference.

To secure data as to the extent of the interference of the naval wireless service by amateurs and others, tests consisting of almost constant communication between the naval wireless stations at Newport, R. I., and at the New York navy yard are being made. When the tests have been completed the results will be forwarded to the Navy Department. Serious delay to the Government wireless service has been caused, it is claimed, by outside operators, chiefly amateurs.

A Paris-to-Munich Telephone Line.

A dispatch from Paris, France, states that a long-distance telephone line will shortly be established between that city and Munich, Bavaria.

The New England Telegraph Company has been authorized by the Supreme Court to change the name to the Postal Telegraph Cable Company.

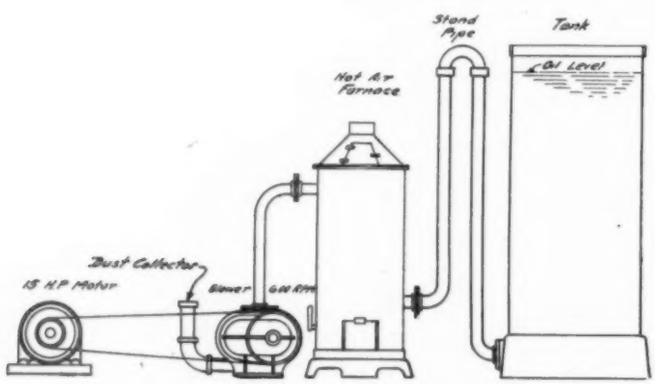
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A New Oil and Transformer Drying Device.

Experience has demonstrated that it is practically impossible to prevent moisture from being deposited in transformers during transportation or storage, as condensation takes place on the surface of the oil and metallic surfaces whenever these are cooler than the surrounding air. It is of the utmost importance therefore that adequate means be provided for drying out the transformer and oil.

The device shown diagrammatically in the cut, designed for this purpose, is manufactured by the General Electric Company, and consists of a hot air furnace, positive pressure blower, dust collector, driving motor, and necessary piping, pulleys and belt. Hot air, free from dust, is forced into the transformer through the oil valve in the base of the tank.



NEW OIL AND TRANSFORMER DRYING DEVICE.

The hot air furnace contains a three-inch wrought-iron coil suitably supported inside a sheet iron casing, the whole being mounted on a cast-iron base. The furnace is designed in a manner similar to a self-feeding stove, two doors being provided, one at the top of the furnace for the admission of fuel, and one at the bottom for removing the ashes and also regulating the draft. Wood and charcoal have proved in actual experience to produce very satisfactory results as fuel, but hard coal may also be used if forced draft is provided, which can be easily accomplished by tapping the pipe between the blower and the furnace. Standard three-inch wrought-iron piping is used throughout, but as it is procurable almost anywhere, only the connection between the blower and the furnace is furnished by the manufacturers. If the connections between the furnace and the transformer tank are of appreciable length it is advisable to cover them with heat insulating materials to prevent the loss of heat.

The positive pressure blower has a normal capacity of 300 cubic feet of free air per minute delivered at a pressure of six pounds per square inch, is designed for a speed of 600 revolutions per minute, and requires fifteen horsepower to drive it when delivering normal output.

The dust collector or air filter consists of a perforated sheet metal pipe four and one-half inches in diameter, connected to the blower with a suitable elbow and forms the point of entrance of the air to the blower. Cheese cloth should be tied around the pipe so that the air in entering the blower may pass through it and the dust be retained in its meshes.

Any available power, as a steam engine, gas motor, electric motor, etc., will drive the blower satisfactorily.

The piping between the furnace and oil tank is extended above the oil level to prevent flooding the furnace with oil if the valve in the base of the tank is not closed when the blower is stopped.

The method of its operation is as follows: After the fire has been started in the furnace the fan should be put into operation. The air is drawn through the dust collector which frees it from all impurities and is then heated in the furnace to approximately 100 degrees centigrade. The hot air being forced through the transformer and oil at a pressure of six pounds per square inch, absorbs all the moisture and raises the di-electric strength of both the oil and windings to its original value. No hard and fast rule can be given as to the time actually required for thoroughly drying out the transformer, but it is believed for ordinary cases of moisture, that a ten-hour run after maximum temperature is attained, will be sufficient. Break-down tests should be made from time to time on samples of the oil taken from the transformer and the drying continued until the oil is able to withstand a puncturing test, the value of which is prescribed by the transformer manufacturer.

The McDonald Concrete Tie.

The McDonald Company, 617 Lissner Building, Los Angeles, Cal., owns the patents of a reinforced concrete tie that is being used in the reconstruction work of the Los Angeles electric railways and is meeting with much success.

The body of the tie is of concrete with internal reinforcement comprising longitudinally arranged bent metal truss rods, parallel reinforcing rods and end plates.

The seats for the rails are in the form of metal plates embedded in the concrete body at the top and bottom thereof. Each plate is perforated with countersunk holes in which the ends of wrought iron sleeves are inserted and expanded. These sleeves form tubular openings through the concrete into which the angular bodies of the spikes holding the rails are driven. The bodies of the spikes used are of rectangular cross section throughout a greater portion of their length thereby providing longitudinal edges which cut into and become embedded in the internal wall of the sleeve. Other forms of construction both for the concrete body and the

shape of the sleeve and spike are specified to conform to various conditions in practice.

The McDonald Company asserts that by following its specifications, railways can construct their own ties at a considerable saving and at the same time have a strong durable track construction.

Show-Window Lighting.

The aim in modern show-window lighting is to show no exposed light in the ordinary range of vision. In this connection attention is called to the accompanying diagram, prepared by the National X-Ray Reflector Company, Chicago, Ill., and based on tests made

HELMET REFLECTOR FOR SHOW-WINDOW LIGHTING.

by that company in a recent study of show-window lighting.

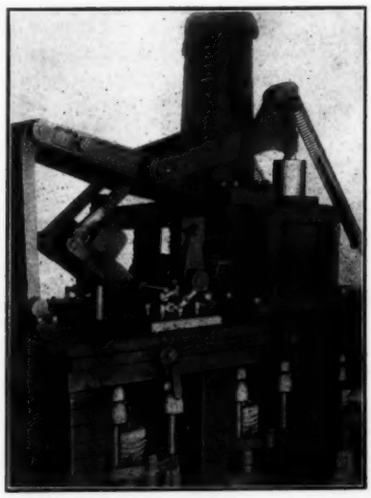
The diagram shows a cross-section of a window seven feet deep which is to be trimmed to a maximum height of seven feet at the back. The lamps are placed thirteen feet above the floor of the window near the ceiling and are equipped with X-Ray Helmet silver-plated opaque reflectors. The distribution of light from this reflector, as shown by tests, is said to be about as indicated by the diagram. It will be seen that nearly all of the light is delivered on the goods in the window.

The Senate committee on commerce has favorably reported the bill requiring ocean going vessels carrying fifty or more passengers to carry wireless apparatus and operators.

Westinghouse No-Voltage Releases Oil Circuit-Breakers.

For controlling eight large 6,600-volt Westinghouse type HF three-phase induction motors, ranging over capacities of 3,200, 2,500, 2,000 and 650 horsepower, in the new merchant mills of the Indiana Steel Company at Gary, the Westinghouse Company has equipped its standard type C circuit-breakers with a no-voltage release device, which secures the instantaneous opening of the gravity-operated contacts when the control voltage is interrupted.

As shown in the accompanying illustration, one of the toggle-joint members of the standard switch-gear is fitted with an armature which engages and is held by the pole pieces of the no-voltage coil, just before the toggle passes its central position. In the ordinary type

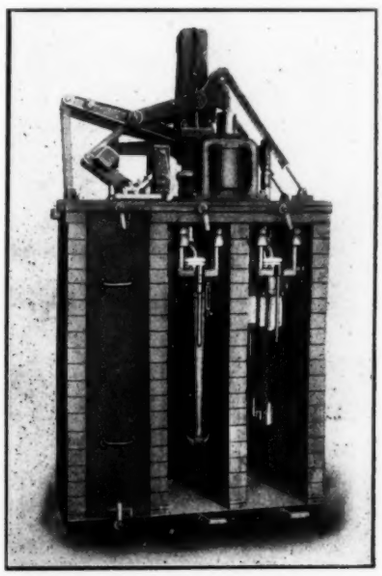


CIRCUIT-BREAKER SHOWING NO-VOLTAGE RELEASE DEVICE.

C breaker furnished without this no-voltage release, the contacts are held closed by carrying this toggle over its dead center, where it locks.

In the no-voltage type, the toggle is detained by the attraction of the pole pieces for the armature, while still on the operating side of its center, so that in case of any interruption to the control voltage the breaker immediately opens, and cannot be closed except in the usual manner. Full protection is thus afforded to the motors connected through their circuit breakers, and in the case of overload on the rolls, or failure of the power house, their circuits are immediately opened, so that the machines must be gradually accelerated in the usual way.

Except for the no-voltage release feature, these circuit breakers are similar to the standard type C oil breakers built by the Westinghouse Company, and include all the features of solenoid operation, oil submersion of contacts, simple lever switch-gear, gravity opening, and minimum quantity of oil required, which are among the advantages of the well known type C breakers. The breaker is designed for mounting in a brick or concrete structure, separate cells enclosing the sheet-metal switch tanks of each phase. There are two contacts per pole, an effective barrier between pairs of contacts being interposed by the operating rod and insulating lining of the tank. No high-tension parts or wiring is exposed when the breaker is assembled. A double-



WESTINGHOUSE NO-VOLTAGE RELEASE CIRCUIT-BREAKER.

throw double-pole switch operated by the controlling levers serves as a telltale, lighting red or green lamps to show the position of the contacts, whether open or closed.

Besides such special services as large motor starting duty, type C oil circuit breakers equipped with no-voltage release will be found extremely useful inserted in the service mains of large power customers where, by opening the circuit promptly, they will relieve the heavy load conditions met by the power house in restoring service after an interruption.

The Shamrock Mills Company, of Winston-Salem, N. C., is about to build extensive additions, in which direct-connected electric motors will be used throughout to drive the machinery.

Engineering Equipment and Power Plant Specialties.

The Electrical Engineers Equipment Company, Fort Dearborn Building, Chicago, Ill., specialize on power plant apparatus, particularly that material which appertains to the high-tension equipment both for inside and outside service. This company makes cable end bells for all voltage up to 28,000 volts delta, clamp insulation pins, bus-bar insulating supports, high tension insulating pins, switchboard and iron frame fittings, pure 98 per cent copper connectors, both solid and split, porcelain insulators, and extra heavy, all glazed floor tubes. All bells are guaranteed to test two and one-half times, wet, above the working voltage.

The company can make immediate shipments from stock consisting of forty-two styles and types of cable end bells, large inside generator pit bells, designed for duplex, triplex and quadruplex lead-covered cables of any size up to 500,000 circular mils.

The accompanying illustrations show some of the types of cable bells manufactured and ready for immediate delivery by this company.

INSIDE CABLE BELL FOR 13,000 TO 22,500 VOLTS.

POLE TYPE, OUTSIDE CABLE BELL.

OUTSIDE CABLE BELL FOR 13,200 VOLTS.

INSIDE CABLE BELL FOR 2,300 TO 13,500 VOLTS.

INSIDE CABLE BELL, LEFT HAND.

INSIDE CABLE BELL, RIGHT HAND.

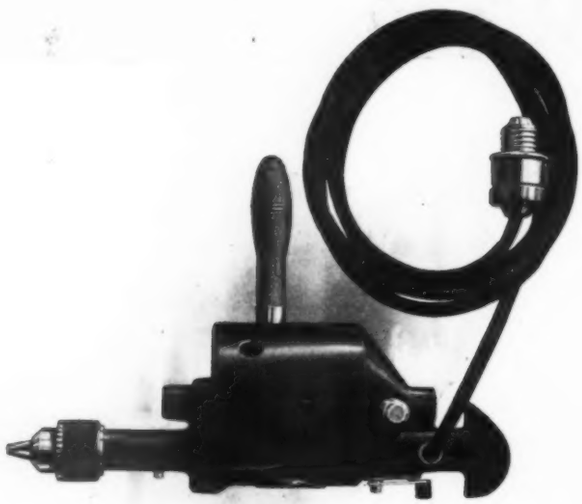


FIG. 2—LAMB PORTABLE DRILL.

New Lamb Electric Apparatus.

In the accompanying illustrations are shown two new electrically operated machines which should interest central-stations desirous of increasing their day loads.

In Fig. 1 is shown a direct-current grinding and buffing motor designed for all classes of grinding and polishing work where quick and efficient work is desirable. The equipment consists of a direct-current motor of rigid construction to which is clamped a tool rest. The motor while totally enclosed is, due to its construction, capable of continuous service. The shafts are extra large and long; the armatures are of the slotted type with the conductors carefully wound in the slots and the

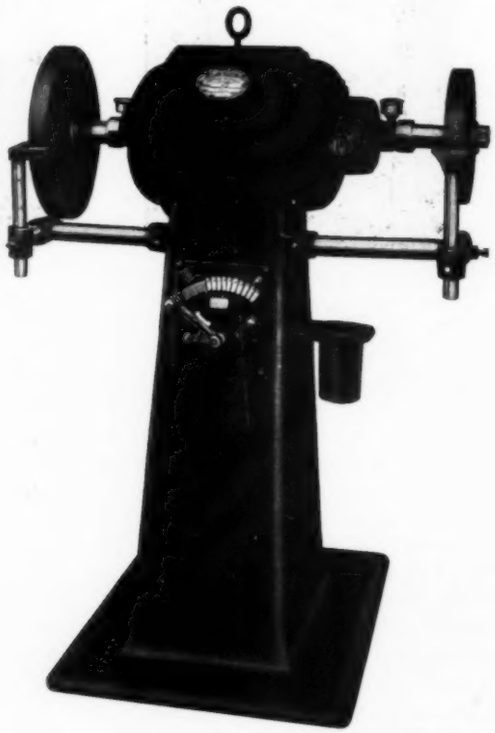


FIG. 1.—GRINDING AND BUFFING MOTOR.

entire construction in such that while each part is easily reached the equipment is thoroughly dust proof.

The portable electric drill, shown in Fig. 2 is designed for either direct-current or alternating-current circuits and paticularly adapted for boring wood, drilling iron, steel, brass, copper, etc. The motors are extremely light, aluminum entering into their construction to a large extent. A sufficient number of vent holes are provided for the proper ventilation of the motors but they are covered with a fine mesh screen to prevent dust and chips from entering the mechanism. The bearings are of phosphor bronze thus assuring long wear. The switch is so placed that it may be operated with the right hand without removing the hand from the handle. The gears are are of steel construction and may be easily removed.

Both the grinders and drills are wound for all standard voltages and

POCKET BATTERY-METER.

may be easily attached to any lamp socket. The small sizes of grinders may be used without a starting device.

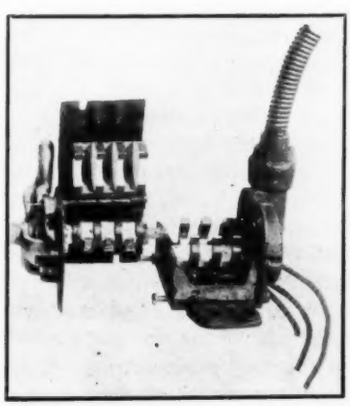
These machines are being placed on the market by the Lamb Electric company, 20 Huron Street, Grand Rapids, Mich.

A New Pocket Battery-Meter.

The Connecticut Telephone and Electric Company of Meriden, Conn., has just placed on the market its new 1910 pocket-meter for battery testing. This instrument is built with jewelled bearings and is manufactured and assembled as carefully as a watch. Another improvement in this instrument is a handsome silver etched metal dial instead of the paper card dial generally used. The Connecticut Company makes a number of different styles of dead beat volt meters and also combination volt and ammeters of the dead type. The voltmeter only is used for testing storage batteries each cell of which should be tested separately and each should show 2.5 volts after the battery is fully charged and still charging. After use when they drop as low as 1.7 volts they should be recharged. The Connecticut ammeter is, of course, only used for testing the condition of dry cells.

Alternating-Current Motor Switch.

The new switch built by the Pneumelectric Machine Company, Syracuse, N. Y., is a simple make-and-break arrangement. Owing to the small amount of current required for the operation of this machine, compensating apparatus for starting the motor is not required nor is it necessary to provide an oil switch for making and breaking the circuit. The automatic throw switch



ALTERNATING-CURRENT MOTOR SWITCH.

is so designed that it is safe to throw the current on or off under full load. Externally this switch resembles the controller made by this company for use with direct-current motors; in fact, it has the same body, cylinder contacts, arc divider, etc., but the lever can stop in but two positions, one at the extreme left and the other the extreme right. By means of a coil spring a lever, and a lock, the cylinder is thrown from one extreme position to the other without the possibility of stopping at any intermediate point. Then starting it must travel the full distance and cannot stop until contact is fully made or broken.

This switch is used by connecting up with the power supply, as in the case of direct-current apparatus, but no resistance is used, and the short cable consists of but three conductors instead of four, and the long conductor has three cables instead of two. The severe service of mining machinery and the liability that machine operators may pull on the cable when moving the machine about, has made necessary means for protecting the cable next to the switch. A conical split wedge of soft metal is forced into the back of the switch frame while the nut holding the armour is screwed in position. This arrangement prevents all possibility of breaking the connections should the switch be abused by the machine operator.

Panel Cutouts with Spool Handles.

For a long time there has been a demand among an appreciable portion of the electrical trade for panel cutouts with more rigid handles, as well as handles that are easier to grasp than the ordinary spool handle, or even the spade handle.

In view of this demand, the Trumbull Electric Manufacturing Company, Plainville, Conn., is getting out a complete line of three to two and two to two wire panel cutouts, on which they are using a spool handle and special blade which fastens in the ends of the

PANEL CUTOUT WITH SPOOL HANDLE.

handles in a groove, so that it is impossible for the handle to turn on the blade. The accompanying cut illustrates the new design.

These blades and handles are the same as used on its panelboard switches, and make an addition to the ordinary panel cutout, which makes it a much superior article, and which is sold at a cost of but a few cents additional.

The secretary of the treasury has awarded to the Marconi Wireless Telegraph Company of America, New York city, at its bid of $1,812.20 the contract for furnishing and delivering two direct current wireless telegraph outfits, one for the revenue cutter Perry and one for the revenue cutter Rush.

Steam Heating From a Central Station.

This distribution of steam through underground mains for supplying heat to the business and residence districts of towns and cities, where weather conditions are severe enough to warrant the investment, is becoming more widely known every year.

Among the advantages to the consumer is the convenience of having heat available in any quantity at any time of day or night without the care and dirt which usually accompanies the furnace.

The central-stations' point of view may be gained from the following brief descriptions of instances where central-stations have embodied such a centralized heating system in their operations.

In Johnstown, Pa., the Citizens Light Heat and Power Company has a system installed in connection with its Vine Street power station. Steam is supplied in this station by 1750 horsepower in Heine water-tube boilers. The system of underground steam distributing mains, is connected to the exhaust piping by one fourteen inch and one ten inch main. The mains have a total underground length of 13,340 feet, exclusive of service pipes.

Steam heat is supplied to 294 business blocks, residences and public buildings containing about 15,458,028 cubic feet of space. The size of the mains is such that all customers are amply supplied with steam with a back pressure on the engines of only two to five pounds, depending upon the demand.

The station piping is so arranged that the supplemental supply of live steam is automatically delivered to the heating system through reducing valves during those portions of the year when the heating loss is greater than can be cared for by the exhaust steam from the engines.

Selecting at random a period of twenty-six consecutive months the following results were found to have been obtained. The total kilowatt hours during this period amounted to 6,856,950 of which 5,252,347 kilowatts were produced during the eighteen heating months of this period. The total cost of all fuel, water and boiler-house labor during the twenty-six months amounted to $52,138.77, the cost during the eighteen months amounting to $40,971,17. The income from exhaust and live steam sold during the twenty-six months amounted to $62,962.64 and during the eighteen heating months to $60,721.92. Thus it may be seen that the receipts from steam furnished during the heating season paid for all fuel, water and boiler-house labor and left a surplus of $19,750.40.

Another interesting installation is in Wilkes-Barre, Pa., where the Wilkes-Barre Heat, Light and Motor Company supplies steam heat to 198 business blocks, 213 residences, seven hotels and six churches, a total of 424 customers whose buildings cover 17,000,000 cubic feet of space.

The boiler equipment in the two stations of this company consists of three 150-horsepower and twelve 100-horsepower horizontal return tubular boilers, all of which carry low pressure and are piped direct to the heating mains.

Steam is turned on the underground system September 15, and kept on continuously until June 1. The service is charged for on the basis of space heated and the class of buildings—the rates ranging from $3.75 to $7 per 1,000 cubic feet of space per season, with coal costing the heating company $1.05 to $1.96 per long ton, delivered.

The Edison Electric Illuminating Company, of West Chester, Pa., a city of about 10,000 population, has in operation a central-station heating system which supplies heat to over 250 customers in business blocks, residences, public buildings and churches.

Both the power plant and the heating system represent the result of much thought expended in an effort to get the greatest possible return from the money spent for coal and labor.

Steam is supplied by three 250-horsepower and one 200-horsepower Stirling boilers. There are about 8,900 feet of underground steam mains installed from which steam is supplied to the customers whose buildings contain about 100,000 square feet of radiation.

A comparison of the results of operation for a period of twelve months shows that the total cost of fuel, water and boiler-house labor for the twelve months was $13,182. The receipts from the heat sold during the nine months more than covered this the actual receipts being $13,255, and in addition this same fuel, water and labor produced 857,293 kilowatts of electricity.

In each of the instances mentioned above, as well as in many more installations the underground heating mains, fittings, expansion variators, valves and meters were supplied and installed by the American District Steam Company, Lockport, N. Y., who for a number of years has been installing, successfully, these district steam heating systems.

New Electric Cooking Range.

A United States patent has recently been granted Jesse Barrett, Niagara Falls, N. Y., on an electric and steam combination cooking range which, when placed on the market, should be favorably received by hotels and in other places where the question of steady, economical heat is one of considerable importance. The principle involved is the conservation of electric heat due to the difference in ratio of heating and radiating surfaces and the utilization of the heat of exhaust steam.

The top of the range is divided into two equal sections. The rear section is heated by the incoming steam, the supply to be taken from any convenient source. The front section is heated by electricity. This section has two duties to perform: first, to heat the top to a medium red heat for cooking, and second, to superheat steam for the ovens, the temperature of the superheated steam to be as desired. If necessary, the temperature of the two ovens may be different, while a portion of the superheated steam may also be admitted to the ovens for direct steam cooking, if desired. Mr. Barrett has studied the problem of hotel cooking at the International Hotel, Niagara Falls, and is very confident his appliance will be found very useful and economical.

Novel Use of Lifting Magnets.

It is reported that a sunken cargo of kegged nails is being raised from the bed of the Mississippi River, near New Orleans, by means of lifting magnets.

The magnet used in the work is three and one-half feet in diameter and weighs 3,000 pounds. It raises five or six kegs of nails, each weighing two hundred pounds from a depth of seventy feet. The kegs are raised intact and the nails are uninjured, and it is estimated that ninety-five per cent of the cargo can be saved.

A cargo of cotton ties sunk near Natchez, and a cargo of woven wire sunk near Pittsburg, will be raised by this method shortly.

The magnet being used is manufactured by the Cutler-Hammer Manufacturing Company.

New English Electric Locks.

In the accompanying illustrations are shown two examples of Sun electric locks, which combine, it is said, all the latest improvements and represent the best types of their kind at present on the market. They can be fitted to any door; in a small recess in the door frame is fitted a spring which opens the door when the lock operates.

FIG. 2.—SIMPLE ELECTRIC LOCK.

These locks, it is claimed, will operate equally well with two or three cells, and they are manufactured in five types. In Fig. 2 is shown the simplest pattern. It contains a very few parts and takes up very little room. It can be used for either right hand or left hand opening doors and is particularly adapted for garden gates. An interesting type of lock also adapted for this purpose is fitted with a chain, which operates the latch of a garden or

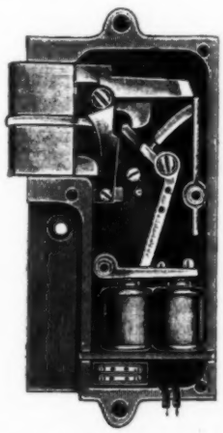


FIG. 1.—SUN ELECTRIC LOCK.

other gate. The operation of closing the door winds up a spring which is held in tension by the magnetic clutch. When the button is pressed the spring is released and draws back the latch of the door, allowing it to be easily opened.

Another type of lock made by the Sun Electrical Company is shown in Fig. 1. It operates in the following way: Supposing the door to be shut, pressure on the electric push button releases the magnetic clutch, and the door, while remaining closed, may be easily opened by lightly pushing or pulling it. When the person had passed through the door it shuts and locks itself, and can only be opened by repeating the above cycle of operations.

Lowden Rotary Mercury High Vacuum Pump.

There has recently been placed on the European markets a new type of mercury pump which has been designed specially to meet the needs of the manufacturer of metal-filament lamps, to whom a very high vacuum is essential.

This pump, which is the invention of W. T. Lowden, consists of two endless circular metal tubes, each with a trap of special design inserted at one point in the circumference.

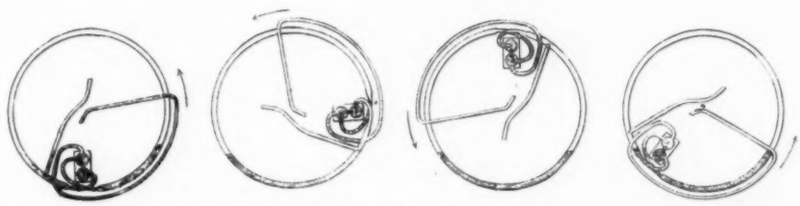


DIAGRAM SHOWING ACTION OF MERCURY IN PUMP AT FOUR SUCCESSIVE POSITIONS DURING ONE REVOLUTION.

The tubes are attached to the inside of the rim of a wheel which is rotated by a small motor at a speed of two revolutions per minute.

Each circular pipe forms a pump, the two being in parallel between the rough vacuum pump and lamps. From one end of each trap a discharge pipe leads to the rough vacuum pump, and in each circular tube a suction pipe enters adjacent to the trap, and connects with the lamps to be exhausted.

The tubes contain sufficient mercury to fill the traps when at the lowest point of the travel, and considering the rotation of the tubes, it is evident that while a portion of the mercury will always remain as an air seal in the trap, the bulk of it being free, will occupy the lowest point of system, and, acting as a stationary piston, drive the air in front through one section of the trap into the delivery pipe leading to the rough vacuum pump, while at the same time an evergrowing space will exist behind the piston, creating a strong suction in the pipe leading to the lamps.

Moreover, assuming the trap to be approaching the lowest piston, it will be noticed that while the mercury piston expels the air in front of it through the delivery pipe leading from the trap, the mercury itself flows down though the trap, ultimately sealing the suction tube and driving the air sucked into the pump during the previous revolution in front of it; a little further rotation and the mercury piston is again formed, the suction tube to the lamps is unsealed and the exhausting action behind the piston recommences.

As the traps are arranged at opposite points in the circumference of the wheel, a steady suction is maintained by the pumps in parallel.

New Shop for the Buffalo Foundry and Machine Company.

Orders have recently been placed by the Buffalo Foundry and Machine Company for buildings and equipment required for their new machine shop. This building is to be erected near the present foundry at a cost of about $200,000.

Orders have been placed for exceptionally large machine tool equipment, all the tool equipment having been ordered special so as to obtain the highest production and get an exceptionally large range of work. All the tools will be motor driven, the motors being twice the size ordinarily used on the same machines. A special study has been made with a view of the elimination of all manual handling.

This company has been widely known for its exceptional foundry plant and its ability to produce castings weighing as heavy as 200 tons, their foundry being the largest, most modern and best equipped general foundry in the country. While their present machine shop is much larger and better equipped than the average, it is not as pretentious as the foundry.

An Electric Sightseeing Car.

The accompanying illustration shows an electric sightseeing car made by the American Motor Truck Company, of Lockport, N. Y. Similar cars were used with success at the Seattle Exposition last year. The seats can be removed and when so done a truck body is ready for use with stake pockets and all necessary fittings on same. These trucks are suitable for carrying three and one-half tons and traveling at a speed of ten miles an hour. When used for sightseeing, the car is geared to travel at twelve to thirteen miles an hour on level hard road with thirty passengers.

The batteries used in these cars are of a new type special high-capacity plate, made up into forty-two cells of seventeen plates each. The batteries have been known to give five hours' discharge at the four-hour rate after being in service for eleven months.

The trucks are equipped with roller bearings throughout, which gives the

ELECTRIC SIGHTSEEING CAR.

car a very slow starting torque and reduces the current consumption and cost of operation while materially increasing the mileage. The batteries have been known to be in service for fifteen months without replacement of any kind. The motors are of the well-known standard-vehicle type, and the controller is designed for four speeds ahead and reverse.

Santa Fe Extends Its Telephone Dispatching System.

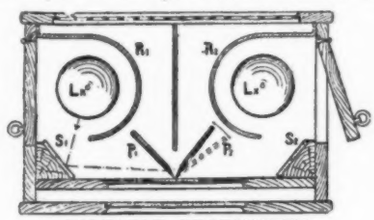
The Atchison, Topeka and Santa Fe Railway Company has extended the use of the telephone for train dispatching over its road from Denver to Pueblo, Colo. The officials of this road were among the first to recognize the advantages of the telephone for dispatching. Telephones have been installed over approximately 1,950 miles of the Santa Fe lines, and it is planned to extend the equipment on other sections of the road as soon as possible.

There are about forty telephone stations on the 120-mile stretch between Denver and Pueblo, and here telephone equipment and Gill selectors supplied by the Western Electric Company have lately been installed. Heavy traffic is carried on over this single track division. There are in the neighborhood of twenty-five to thirty trains a day, and in the handling of these trains there are approximately seventy-five regular meeting points. This section of the track is used jointly by the Santa Fe and the Colorado and Southern railways. The dispatching, however, is all done from Pueblo by the Santa Fe.

It is estimated that the installation of telephones on this division will enable the dispatchers to handle the same amount of work as previously in about sixty per cent of the time.

Portable Photometer for Filament Lamps.

The photometer shown in an accompanying illustration, with which is combined a lamp voltmeter and wattmeter, is made by Hartmann & Braun,



PORTABLE PHOTOMETER.

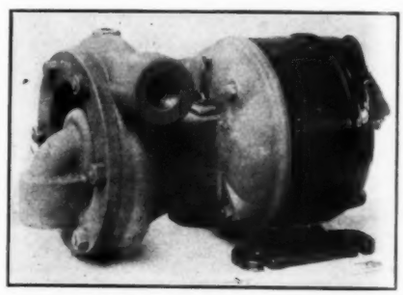
A.G., of London, Eng. In the illustration R_1 and R_2 are two semi-cylindrical chambers, one for the standard lamp *Ln*, the other for the lamp *Lx* to be measured. The lamps being hung up, light from them reflected from the mirrors S_1 and S_3, on to the transparent surfaces P_1 and P_2. P_1, which receives the light of the standard lamp, is fixed, but P_2 can be moved as shown by the dotted lines. The front of the case is of ground glass, with a transparent circle in the middle, half of which is illuminated by each lamp. P_2 is then moved until the illumination of the two halves is the same. The ratio between the cosines of the two angles of incidence gives the ratio between the lights, and a scale attached to the case permits of this being read off at once by means of a pointer actuated by the motion of P_2.

It can be seen that in this arrangement much has been gained in the way of compactness over the sliding-scale photometer.

Electric Pumps for Household Water Supply.

In that rapidly enlarging class of country houses and isolated homes where electrical power is available, the dependency for water supply need no longer rest on the unreliable and expensive operation of windmills and gasoline engines. Theoretically cheap as these agents are supposed to be, the one involves a large first cost with a service as little dependable as the wind which serves it, while the other requires the attention of a trained mechanic to supervise the complicated engine, to say nothing of the explosive nature of the fuel employed, and the dangers of ignorance in its operation.

As shown in the accompanying illustration, the motor-driven volute pump for this class of service is compact and solidly constructed. The motor is of the Westinghouse alternating-current in-



MOTOR-DRIVEN PUMP.

duction type, in which all special or delicate parts have been eliminated, resulting in a thoroughly dependable, sturdy, completely enclosed electrical machine, which transmits its output through a shaft directly to the impeller blades rotating in the cast-iron case seen at the left. This volute pump is designed to deliver 800 to 1,000 gallons per hour against heads up to fifty feet, when running at 2,800 to 3,300 revolutions per minute. The intake is shown at the left, entering at the center of the pump case, while the discharge orifice is the hole, threaded for a one-inch pipe, seen opening toward the observer. There are, of course, no valves in this pump, and packings, pistons, etc., are also eliminated. The pump, which is arranged to be bolted to the motor frame, making a compact unit, was designed and built by Henry R. Worthington, Harrison, N. J. Motors for this class of duty are built by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, MARCH 17.—An important judgment was delivered in the Chancery Division of the High Courts recently in which it was laid down that the well-known Ilgner system of driving a reversing rolling mill is not good subject matter for a patent. Consequently, although it was held in the same judgment, that a certain installation in the Midlands, which was put down by a British firm in defiance of the Ilgner patent, was an infringement of the patent, the patentee has no redress. It was laid down in the judgment in question that the Ilgner patent was merely a combination of the Ward-Leonard system of control with a fly-wheel. In the light of electrical knowledge in 1902—the date of the Ilgner patent—the judge expressed the opinion that there was no novelty in such a combination and that it led to no new or unexpected result. Indeed, it was pointed out that S. Z. de Ferranti in a patent in 1895 had devised a system which obviously led to the Ilgner system. This result reduces the electrical patent actions in the law courts, the only one of any importance upon which judgment has yet to be pronounced being the "Z" electric lamp infringement case.

Picture palaces, as they are known, or cinematograph shows, have become such a feature of English life during the past year or two, that the Home Office has deemed it necessary to issue regulations concerning them. A special section is devoted to the use of electricity, as several fires have occurred in connection with the cinematograph apparatus. It is laid down that when the lamp is working, the pressure across the terminals of the double pole switch inside the enclosure shall not exceed 110 volts. The operator is also ordered to make a thorough inspection of the electrical arrangements before each performance. Further, a means of control of the mechanism inside the enclosure is to be provided outside, so that the control is not only in the hands of the operator.

Judgment has been given in the action taken by the "Z" Electric Lamp Company against the English agents of the Bergmann company of Berlin, for infringement of its metal filament lamp patent. The patent in question covered the use of the substance phosphum in the preparation of the lamps, the object being to remove the last traces of carbon in the filament. For the first time the Bergmann company, at the trial admitted that it used phosphum in the manufacture of its lamps, but denied that it did so with the object of removing the carbon. The company's case was that its filaments are, by means of the ordinary processes of manufacture, to all intents and purposes, freed from the last traces of carbon, and that the use of phospham was, in combination with phosphorous, to improve the vacuum. The courts, however, have found that the Bergmann company infringed the patent by the use of phospham in making its lamps and ordered an inquiry as to damages.

It is proposed to hold a national exhibition in London in the Autumn of 1911. The first exhibition of this character was held in London in 1906, and then in Manchester in 1909. The 1911 exhibition, like its predecessors, will be run by the National Electrical Manufacturers' Association.

Following the recent announcement of the Council of the Institution of Electrical Engineers that it does not interpret the articles of association as authorizing it to deal with commercial and legislative matters, comes the notice of the formation of a separate outside committee with this object in view. The idea is to form a new association to work in harmony with existing societies. The provisional committee consists of twenty-four members and includes some of the leading men of the industry. This, however, is the third attempt in the same direction and it will be interesting to watch whether any real progress is made this time. Everyone is agreed that the legislative, commercial and industrial interests of the electrical industry need looking after—at present they seem to be quite neglected—but until there is a little more confidence and a little less suspicion between the various sections of the industry, there is little prospect of any real advance being made.

Considerable use is being made of metal filament lamps in England for the purposes of street lighting, and the latest authority to experiment with them is the Westminster City Council. This council has earned notoriety in that its engineer has had in the streets every conceivable form of lighting at various times and he issues periodically most instructive reports on his experiences. In many other places in London and throughout the provinces, metal filament lamps are being used instead of arc lamps; indeed, where small candle powers are required metal filament lamps are regarded as serious competitors with arc lamps. G.

CONTINENTAL EUROPE.

(Special Correspondence)

PARIS, MARCH 12.—In order to meet the increasing demands for current, the St. Denis electric plant in the suburbs of Paris is soon to install a new steam turbine and alternator group. At present there are erected in the station ten turbine groups of the Brown-Boveri type and these units have an output of 10,000 horsepower. The new turbine set will be built at the factory of the Cie. Electro-Mecanique in the suburbs of town. The firm has the license from the Brown-Boveri Company for constructing this type of turbine in France. It is now proposed to build groups which rate as high as 15,000 horsepower, and these can even be run at 20,000 horsepower, and the present turbine will be one of the first of this type to be built. The alternator is of the three-phase type and is designed to supply 10,000 volts. What is noticeable is that the present groups will occupy no more space than the former 10,000 horsepower turbines.

Extensive applications of electric motors for cranes and conveyors is planned for the port of Bordeaux. The work is designed to give additional facilities for handling coal and various kinds of freight and the apparatus will be mainly used for unloading the vessels of the port. The Orleans company has the matter in charge, and is drawing up the plans for the installation. Four electric cranes of large capacity are among the machines, and these will deliver 270 tons per hour. The cranes take up the coal from the boats and drop it in a receiver from which an electric conveyor will take it to the coal yards for over a mile distance from the port.

Innsbruch, Austria, is now receiving current from a large station known as the Sill plant, which has been erected not long since. It is worthy of note from the fact that high voltage direct current is used for some of the electric traction lines. At present there are six units installed in the station and these give a total of 20,000 horsepower. Current is produced in this plant on the two-phase 11,000-volt system. Two substations, one at Wilten and the second at Innsburch, contain rotary groups which supply 500 volt and 1,000 volt direct current. An electric traction line is supplied with current from the substations. This line runs from Berg Isel to the Inn river, then crosses the latter and reaches Stadt Hall. From the starting point as far as the Hungerburg railroad, the new line uses 500 volts direct current, but from this point to the terminus it employs 1,000 volts. Where the line passes through Innsbruch it uses the city tramway tracks and consequently employs low voltage over this section. The cars are of the double truck type and carry two sixty horsepower motors.

At Constantine, in the Algerian region, there is a project for building an electric tramway for the town and suburbs. The town of Lamoricière is considering a public lighting project. Brest, France, is soon to apply for bids for electric lighting. At Nice, the Municipal Council has now voted the necessary funds for the lighting of docks and other quarters of the port.

Relating to the project of securing a power supply for Naples from a turbine plant on the Volturno stream, fifty-five miles distance, measures are already being taken for building a second hydraulic plant at a point lying below the first one, and the current will be brought to the city over the same power line, which works at 45,000 volts. In this way the amount of power available for Naples will be increased to 20,000 horsepower, not counting the new steam plant of 6,000 horsepower which will also be erected in the city.

At Prague, Austria, there is proposed an extension of the city tramway lines. Among other Austrian projects I note an electric traction project for the town of Fehertemplom and the suburbs, also a new electric line for the commune of Modor. A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., MARCH 18.—The Trinidad Electric Company has declared the regular quarterly dividend of one and one-fourth per cent. The annual meeting of the stockholders will be held in Montreal on April 14.

The International Waterways Commission will meet at Toronto on April 15 to hear further argument and evidence in regard to the Long Sault dam project. It is probable that immediately afterwards a decision will be rendered.

The Electric Development Company of Toronto, has placed an order with the Canadian General Electric Company for three new generators, each capable of generating 15,000 horsepower. As

the present capacity is 50,000 horsepower, it will be seen that the augmented plant will have a capacity of 95,000 electric horsepower.

The Ontario government has passed a bill through the legislature of the province which gives power to the hydroelectric commission to regulate and inspect, under a penalty of $100 a day for noncompliance with their orders, the operation and equipment of the works of all municipalities and corporations supplying power and light.

The chairman of the Ontario hydroelectric commission announces that the commission already has contracts for the supply of power in a number of cities and towns in eastern Ontario, and intends to extend its operations in that section as fast as the work can be done. This announcement was called forth by the statement made in Dominion parliament that the commission had no intention of supplying electric power in eastern Ontario.

There are three underground railway projects in prospect in the city of Montreal at the present time. The latest is the Montreal Street Railway Company which is now seeking a charter to build and operate a subway system. Another organization is already in the field and has offered its stock to the Montreal public, although it was recently stated that enough American and European capital was assured to finance the scheme. This company has already filed an application for a charter with the government, asking authority to build and conduct an elaborate system of underground transportation, and to issue bonds to the extent of $20,000,000. The pioneer, however, of the present situation is the Montreal Central Terminal Company, which has London and New York backing, and is already empowered by acts of parliament to build and operate a subway system in the city of Montreal. W.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

POWER PROJECT FOR MEXICO.—Another great electric power enterprise for Northern Mexico is said to be assured. Frank A. Liliendahl of Saltillo, who is well known in financial and business circles of Mexico and the United States, through his successful promotion of the Cohuila & Pacific railroad that is now a part of the National Railways of Mexico, has been working on this electric power project for the last three years. It is announced that he now has the financial arrangements closed, a syndicate of New York men having taken hold of the project. The government concession which Mr. Liliendahl holds for this enterprise provides that the hydroelectric plant shall be erected on the Pilon River near Montemorelos, State of Neuvo Leon. The initial capacity of the plant will be 15,000 horsepower, but this will be increased to 100,000 horsepower as rapidly as the demand for the electrical energy increases. The chief market for the power will be in Monterey, which is the principal manufacturing and industrial center of Mexico, having a population of about 80,000 people. Electric transmission lines will also be built to Saltillo, Victoria, Linares and a number of other smaller towns. It is forty-eight miles from the site of the proposed hydroelectric plant to Monterey. The surveys for the plant have been made and construction will soon be started, it is announced. D.

TO REPLACE TEXAS DAM.—The city council of Austin, Tex., has entered into a conditional contract with the Dumont-Holmes Steel Concrete Company, represented by J. C. Dumont, for the construction of a new dam across the Colorado River at Austin, to replace the great structure that was destroyed by a flood several years ago. Embraced in the contract is the installation of a complete hydroelectric plant. The city is to pay for the works in forty semi-annual installments of $25,000 each, or a total of $1,000,000. The dam will be sixty-five feet high and several hundred feet long. It will be located near the site of the old one and will form a reservoir about thirty miles long by one-quarter to three miles wide. The proposition of the Dumont-Holmes Steel Concrete Company received the endorsement of the local Business League before it was submitted to the city council. In order to make the contract effective it must be approved by vote of a majority of the taxpayers of Austin. It will be submitted at a special election to be called as soon as the necessary arrangements for same can be made. It is thought that the proposition will be carried by a large majority. The proposed dam will furnish power for operating the municipal water and light plant and waterworks system. It is expected that the city will be in position to sell a large amount of excess power. D.

A NEW POWER SYSTEM FOR TEXAS.—The Colorado River Power Company, of Marble Falls, Texas, having a capital stock of $1,000,000, has filed its charter in the secretary of state's office. The company will soon have completed a great dam across the Colorado River at Marble Falls at a cost of several hundred thousand dollars and the erection of a hydroelectric plant will soon be started. This proposed plant will have an initial capacity of about 5,000 horsepower and provision is made whereby additional water storage can be easily obtained that will afford double the amount of the power of the original plant. The company is preparing to build transmission lines to San Antonio, ninety miles; to Austin, thirty-five miles; to Waco, 100 miles, and to a number of smaller towns within a radius of 150 miles. It has also contracted to furnish electric power for a cotton mill and other industries at Marble Falls. The dam is 750 feet long, fifty feet high and has an eighty-foot base with a sixteen-foot crown. It is a sluice dam, with chambers in the interior, and is made of concrete reinforced with steel. The dam was designed and constructed by J. C. Dumont, who is also negotiating with the municipal authorities of Austin for the building of a similar structure across the Colorado at that place. It is claimed that in several respects the Marble Falls dam is the most novel and remarkable in this country. The water of the river will course through it, instead of over it. Through its center is a broad causeway and upon its crest a railway will be built, the dam being used for a bridge. The incorporators of the company are C. H. Alexander and James O. Wiley, of Dallas, and E. C. Alexander, of Marble Falls. D.

LIGHTING AND POWER.

(Special Correspondence)

DIXON, CAL.—E. D. N. Lehe has been granted an electric lighting franchise for this town. A.

REDWOOD FALLS, MINN.—A company has been organized to build dams here at Odessa and the head of Big Stone Lake. C.

DAVENPORT, IOWA.—Merchants have incorporated as the 100 Block East Third Street Association to install street lights. C.

SALT LAKE CITY, UTAH—The Ely Centennial Mining Company is adding a complete electric lighting plant to its equipment.

SEWARD, NEB.—Boyes, Hulshizer and Company propose to rebuild the dam on the Blue River and will probably put in an electric light plant. C.

RAYMOND, WASH.—The South Bend-Raymond Electric Company will extend its wires to the section of the city across the South Fork. C.

LA GRANDE, ORE.—An electric dynamo is to be installed at the railroad power house for the lighting of the shops and yards. A.

NORWOOD, OHIO—The Norwood Light, Heat and Power Company has been incorporated with a capital of $15,000 by Langdon P. Hopkins.

BYRON, WYO.—The Big Horn Water, Light and Power Company has been formed to supply Byron, Cowley and Lovell with light, power and water. C.

NORWOOD, O.—The Norwood Light, Heat and Power Company has been incorporated with a capital of $15,000 by Langdon P. Hopkins and others.

FAIRBURY, NEB.—A vote will be taken April 26 on issuing bonds for $135,000 for the purchase or installation of an electric light and water works plant. C.

INDIANAPOLIS, IND.—A contract for installing the lighting fixtures in the new city hall has been awarded to the Sanborn Electric Company at $17,243. S.

SHAMOKIN, PA.—The sale of the Shamokin and Coal township electric light plants to New York capitalists has been practically consummated for $500,000.

BLACK RIVER FALLS, WIS.—Day power will be furnished from the power plant to the factories here. This extension to the electric service will cost about $7,000.

LEBANON, PA.—The charter of the Palmyra Electric Light and Power Company has recently been recorded. The capital stock of the company is $20,000. Daniel Weaver is treasurer.

EMMETSBURG, PA.—The Postville Light and Heating Company has been incorporated with a capital of $25,000. Noble Wilcox, B. N. Allen and T. C. Murray are the incorporators.

DELAVAN, WIS.—The plant and equipment of the Delavan Light and Power Company was sold at sheriff's sale for a consideration of $18,000. George M. Cantwell was the purchaser.

BROWNSVILLE, TEXAS.—The property holders of Brownsville have voted an issue of $30,000 of bonds, the proceeds of which will be used to improve the local electric light and power plant. D.

PORT TOWNSEND, WASH.—The Key City Light and Power Company has been incorporated with a capital of $80,000, by John Sillenbaum, Peter Mutty, N. D. Hill, J. M. Kinkaid and Sam McGee.

TRENTON, N. J.—The Trenton Power Company has been incorporated with a capital of $310,000 by J. DeW. Duncan, H. F. Price and James Fry. The company will operate water, gas and electric works.

STREATOR, ILL.—The Streator Heat and Light Company has been incorporated by D. Heenan, J. Mannix and N. P. Breen, of Streator, to operate a light, heat and power plant. The capital is $25,000.

PORT ANGELES, WASH.—The Port Angeles Power and Electric Company has been incorporated with a capital of $30,000, by Frank MacKean, R. H. Bethel, George D. Brown, William Tyrrel and Julian R. Becker.

BAY CITY, TEXAS——The City Council has closed a contract with the Crystal Ice and Light Company of Bay City for fifty street lights, each to be of thirty-two-candlepower. The company is installing new machinery. D.

PITTSFIELD, MASS.—It is reported that an addition to cost between $50,000 and $60,000 will be made to the power house of the

Stanley Electric Company. This will practically double the capacity of the present power house.

TACOMA, WASH.—The Seattle-Tacoma Company has announced, through Manager Morton Ramsdell, its decision to spend $500,000 in equipment and to generate 10,000 additional horsepower in its Snoqualmie Falls plant. A.

TRENTON, N. J.—The Trenton Power Company has been incorporated to operate water, gas and electrical works, with a capital of $310,000. The incorporators are: J. De W. Duncan, Philadelphia, Pa.; H. F. Price, J. Fry, Trenton.

BESSEMER CITY N. C.—The Osage Manufacturing Company, at Bessemer City, has decided to partially equip its plant with the electric drive, using about 200 horsepower of electricity to begin with. This mill is equipped with 14,000 spindles.

LACONIA, MASS.—The Laconia Gas and Electric Company has recently purchased the property of the Laconia Electric Lighting Company and has acquired the waterpower at East Tilton. About 1,200 horsepower will be developed and transmitted to the city.

LOGANSPORT, IND.—D. D. Fickle, Joseph Stewart and others, are planning to improve the Taber dam in the Wabash river and install a hydroelectric plant. Experts have declared that a 250 horsepower generating plant can be installed without great cost. S.

LAFAYETTE, IND.—Official announcement is made by the Monon Railroad Company that a large addition to the shops would be erected here this summer and that they would be thoroughly equipped with the most modern electrical machinery and appliances. B.

LITTLE ROCK, ARK.—Appropriations have passed the City Council for $5,000 to be used in constructing, and $50,000 in equipping a municipal electric light plant. The Board of Public Affairs is now in position to proceed with the work of building and equipping the plant.

ASHLAND, WIS.—An effort is being made by A. E. Appleyard to have electrical power transmitted to the towns of Hurley and Ironwood from the dam to be built at Cooper Falls. Ironwood has been asked to grant a franchise to the Ashland Lighting Company to furnish power. M.

COLUMBIA S. C.—Contract has been awarded to the Southern Power Company by J. M. Greer, president of the Easley Cotton Mills of Easley, to furnish 250 horsepower, or as much more as may be desired to supplement the power now used to run the mills; also to light the mill village.

SYRACUSE, KANSAS.—This city has voted on and issued $39,000 in bonds for a municipal electric light plant to be constructed very soon. The plant, for which contract has not yet been warded, will be alternating current and of 100 or 125 kilowatt capacity. James Ford is mayor.

SPARTA, TENN.—Work has been resumed on the plant of the Anderson-Tubb Power Company below town, and the plant will be put in operation at the earliest possible time. Electric lights will furnished to Sparta, and a day current supplied. The plant will cost in the neighborhood of $50,000.

LOS ANGELES, CAL.—W. M. Garland and others of this city are planning for the illumination of Boyle avenue, a distance of over four miles. Out of a total frontage of 42,240 feet, 22,500, or almost the required half, have been secured. The plans call for a total of 4,200 lights at a cost of approximately $50,000. A.

MISHAWAKA, IND.—A company of Ft. Wayne merchants and others visited this city March 9th, and made a careful inspection of the lighting system in operation here. An ornamental lighting system is to be installed on Calhoun street in Ft. Wayne, and those interested are desirous of securing the latest and the best. S.

SANTA FE, N. M.—An application for the Rio la Casa Power Plant has been filed in the office of territorial engineers. The applicants are J. J. Laubach, W. G. Benjamin, W. E. Bunker and Wm. Harper. The plant will be located forty miles from Las Vegas on the Rio la Casa and will generate about 2,500 horsepower. A.

CONNERSVILLE, IND.—The farmers in Fayette county for a radius of five miles or more from this city are wiring their houses, barns and outhouses with a purpose of using electric light and power to be furnished by the Connersville Light, Heat and Power Company, which is now building lead wires into the country districts. S.

JOURDANTON, TEX.—A $30,000 electric light, ice plant and waterworks will be erected at once. The following directors of the company have been elected: E. M. Tom, F. P. Wallace, I. W. Wallace, R. P. Coon and B. B. Vaughtry. The officers are: President, L. M. Tom; general manager, F. P. Wallace; treasurer, B. B. Daughtry; secretary, J. W. Wallace.

TAYLOR, TEXAS.—The International & Great Northern Railway Company has contracted with the Citizens' Light and Power Company of Taylor for electrical energy amounting to two hundred horsepower, night and day service, for operating the machinery of its new roundhouse and machine shops. The Citizens' Light and Power Company will install two additional boilers and a new engine. D.

ATHENS, Ga.—The James White Power Company has been formed by James White and others for the purpose of building and operating an electric plant at Barnett Shoals. The capacity of this generating station is to be 4,100 horsepower, and the cost is estimated at $250,000. The chief user of this power will be the Star Thread Mills, of which James White is owner.

CLINTON, IND.—J. W. Robb and C. M. Poor, together with associates identified with the Clinton Electric Light and Power Company, Clinton, Ind., have purchased the Torr Electric Company of Farmersburg and Shelburn, Ind., and the Sullivan Electric Company, of Sullivan, Ind., and will remodel the entire system and replace the now obsolete machinery and outside equipment

INDIANAPOLIS, IND.—The effect of competition on prices for electrical current for lighting and power has been demonstrated by the Board of Public Works by letting a contract to the Merchants Heat and Light Company for current for lighting, elevators, vacuum cleaner and fan motors for the new city hall at 2.41 cents per kilowatt hour. The next lowest bid was 3 cents. S.

LOS ANGELES, CAL.—A corporation, known as the Ramona Power Company, has been formed. The capital stock amounts to $2,000,000. The company will build a new dam on the north fork of the San Jacinto River and develop electrical power from the water flowing over the Hemet Dam. Associated with the power company are Messrs. Erhman, Grigsby, Roy Jones, R. M. Miller, MacPherson and Ben Hunter.

ALBUQUERQUE, N. M.—The electrical equipment of the Santa Fe shops in this city is being enlarged by the addition of a 150-kilowatt three-phase alternating current generator, to be used in connection with the two 150-kilowatt machines in present use. All open work in wiring here and elsewhere in the entire Santa Fe system is being put in conduits. C. C. Williams is chief engineer in charge of the Albuquerque plant.

GRAND FORKS, N. D.—The council opened bids for the proposed improvements and additions to the electric light station from Hess & Rau, Chicago; the Ridgeway Dynamo and Engine Company, Chicago; R. B. Whitman and Company, St. Paul; Erie City Iron Works; Cadwell & Brown Company, Minneapolis; Northwestern Electric Equipment Company, St. Paul, and J. G. Robertson, St. Paul. The bids ranged from $13,713 to $16,611. C.

JACKSON, MISS.—The organization of the new Jackson Railway and Light Company, capital, $1,000,000, was perfected March 5, with the election of officers as follows: T. McCleland, president; W. J. McGee, vice-president; S. T. Carnes, treasurer; Ben H. Wells, secretary. This company has assumed control of the Jackson Electric Railway Light and Power Company, the Jackson Gas Light Company, and the Edwards House and City Railway.

RICHMOND, IND.—The report for February for the municipal light plant, in charge of Superintendent Johnson, is as follows: Receipts from street lighting, $1,931.35; from lighting and power, $8,695.26; from other sources, $278.95. Disbursements: operating expenses, $3,557.14; building and equipment, $924.63; making a total disbursement of $4,481.77. Receipts over operating expenses, $7,348.32. Amount now on hand in electric light fund, $12,152.14. S.

YORK, PA.—The Yorkhaven Water and Power Company, a $3,000,000 corporation, has gone into receivership, Edwin F. Baker, secretary and manager of the company, being appointed receiver. The company's plant is on the Susquehanna River, and supplies current for commercial purposes to York, Harrisburg and Steelton. The appointment of a receiver is attributed to the drought of last summer and the suit of the Yorkhaven Paper Company for prior water rights and damages.

CRAWFORDSVILLE, IND.—The city council and the municipal light plant trustees are considering whether it is best to enter into a contract with the Ben-Hur traction company to furnish current to the city or to construct and equip a new plant, the old municipal plant having depreciated beyond repair. J. W. Esterline, an electrical engineer has been employed to make estimates as to the cost of a new plant and to consider the feasibility of taking current from the traction company. S.

FRESNO, CAL.—The Coalinga Water and Electric Company has filed a certificate of bonded indebtedness providing for the issuing of bonds to the amount of $2,000,000. The issue will include 2,000 bonds of a par value of $1,000 each and will bear six per cent interest redeemable on January 1, 1940. The company has a capital stock of $2,000,000 of which one-quarter is preferred and the best common stock. Of the total, $1,000,000 of the common and $500 of the preferred has been subscribed. A.

COLORADO SPRINGS, COL.—A second mortgage of $1,350,000 has been filed on the property of the Central Colorado Power Company, to the Knickerbocker Trust Company, of New York City. The property mortgaged includes the following: Hine reservoir on Williams fork of the Grand River, capacity 73,097,164,000 cubic feet; the Big Colorado reservoir on the Grand River, 299,400 acre feet; Aspen reservoir No. 1, on Roaring Fork, 43,560,000 cubic feet; C. M. reservoir on the Frying Pan, 494,400,000 cubic feet; Mt. Olympus reservoir, 4,356,000,000 cubic feet, on the Big Thompson River; Curtis reservoirs Nos. 1 and 2, on Blue River in Summit County, 3,000,000,000 cubic feet; Nederland reservoir, 506,475,000 cubic feet; Barker Meadow reservoir, 678,027,500 cubic feet; Hine Reservoir No. 1, 3,513,000 cubic fet, on Williams Creek.

ELECTRIC RAILWAYS

(Special Correspondence)

HOBOKEN, N. J.—Work on the Hudson River Trolley line will begin in a short time.

CHISHOLM, MINN.—The Northern Traction Company will build a line to Hibbing, Minn. C.

LA CROSSE, WIS.—The La Crosse City Railway Company will expend $30,000 in double tracking some sections of its lines. C.

RENTON, WASH.—The council granted the Valley Railway and Power Company a franchise to operate a railroad to Kent, Washington. C.

CENTERVILLE, IOWA.—The Southern Iowa Traction Company has raised $500,000 for improving the line, putting in power plants, terminals, extensions, etc. C.

MADISON, WIS.—The Western Indiana Construction Company has charge of the construction of an electric road to Lodi. Work will be started early in the spring. C.

MUNCIE, IND.—H. A. Nichols, general manager of the Indiana Union Traction Company has announced that the company will double its tracks between this city and Indianapolis. S.

NEW BERN, N. C.—The Neuse-Trent Traction Company is a new concern organized by C. L. Stevens, W. G. Gilbert, of New Bern, and others. The capital authorized is $300,000, and the company proposes to begin operations as soon as possible. L.

GRIFFIN, GA.—The Griffin City and Suburban Railway Company, has been incorporated with $25,000 capital stock by H. H. Bass, J. P. Nichols, B. R. Blakely and others to build a street railway system in Griffin. It is proposed to lay about five miles of track. B.

VIDALIA, GA.——Building of trolley line from Vidalia to Gillis Springs, eight miles, is proposed. A. L. Gillis, Gillis Springs, and Messrs. Powell & Sneed, of Vidalia, are interested. It is proposed to operate the road with power derived by developing fall on Penhoopee River, near Gillis Springs. B.

PORTLAND, ME.—The Portland, Gray & Lewiston Railroad corporation has secured several parcels of land in New Gloucester and Gray and it is understood that work on the new line will be started as soon as the frost is out of the ground this spring. It will be pushed forward as rapidly as possible.

FT. WAYNE, IND.—The Ft. Wayne and Wabash Valley Traction Company has just completed a modern elevator shaft, in connection with the new coal-carrying equipment installed at its Spy-Run power house at a cost of $10,000. The elevator and carrier are attracting much favorable attention. S.

EVANSVILLE, IND.—General Manager Carson, of the Evansville Railway Company, announced that the company will begin at once the work of building their extension from Rockport, Ind., to Grand View, Ind. Later the road will be built to Cannelton, Ind., and Tell City, Ind., and it is hoped to eventually to build to Louisville.

BROWNSVILLE, TEXAS—It is reported that the Rio Grande Railroad that runs between Brownsville and Point Isabel, twenty-two miles, will be converted into an electric line. This road recently passed into the hands of the Frisco Railroad interests. Point Isabel is a popular fishing and bathing resort, being situated on the Gulf coast, near the mouth of the Rio Grande. D.

ABERDEEN, WASH.—Both local and New York capital, the latter to the extent of $1,500,000, will be used in building a new interurban road to Seattle, for which C. C. Quackenbush will ask the franchise. It will be shorter by forty-seven miles than the present railroad between Aberdeen and Seattle, and will own its right-of-way, seventy per cent of which already has been secured.

TOLEDO, OHIO.—The passenger and freight earnings of the Ohio Electric during the month of February exceeded those of any previous month in the history of the road's operation. Much of the increase is attributed to the recent establishment of a down-town office in Toledo. The present terminal of the company is inadequate to handle the company's business, and it is said that a centrally located terminal building may be erected. H.

TOLEDO, OHIO.—It is estimated that the recent breakup of the Maumee River will cost the Toledo Railways and Light Company not less than $25,000. The high water washed out a large amount of track on the Maumee-Waterville branch and it will be necessary to replace many of the poles and much of the wire. In order to handle fuel in case of a flood on Water Street a temporary bridge or trestle was constructed from Summit Street to the power house at heavy expense. General Manager L. E. Beilstein says the company will be out many thousands of dollars. H.

TOLEDO, OHIO.—G. M. Patterson, general freight and passenger agent of the Toledo & Chicago Interurban, originally projected by F. E. Seagrave and other Toledo men, has issued a table folder, showing not only the time of the company's own trains but that of the steam trains leaving junction points, containing a condensed through time table of connecting interurban railways, and much valuable information concerning cities and towns through which the road operates, with general information about the operation of its own line and all steam and electric connecting roads. H.

DALLAS, TEXAS.—It is stated by C. L. Wakefield, one of the chief promoters of the proposed interurban electric railway that is to be built between this city and Terrell, Texas, that good progress is being made in the preliminary plans. It is expected that the route will soon be definitely located. All the right of way by one of the prospective routes has been secured, and work is now in progress securing the right of way via the other route. One of the routes runs via Chisholm and the other via Talty. It will take about one year to construct the road. D.

MORRISTOWN, N. J.—Announcement has been made by the Morris County Traction Company that work on the construction of the line between Boonton and Denville is started. The work is in charge of the Tennis Construction Company, of Pittsburg, it having been sub-let by the Morris County Construction Company, which holds the contract. It was stated also that work on the line between Morris Plains and Denville would be started this month. With this completed, which is a distance of three miles, a direct line will be in operation from Morristown to Lake Hopatcong.

SAN ANGELO, TEX.—The citizens and property owners of Angelo Heights are circulating a petition to raise a $13,000 bonus for the extension of the street car system to that section of the city. Forces of men are at work on a line to East San Angelo, and cars will be running on that line within the next few weeks, it is announced. With further extensions to Angelo Heights the greatest needs of the city along this line will have been provided for. The street car company proposes to belt the city, a franchise granting the streets for this purpose having been accepted by the city council some time ago.

COLUMBIA, S. C.—The Greenville, Spartanburg & Anderson railroad, which, on an initial capital of over $300,000 and ultimate capital of $2,000,000, proposes to extend the Anderson-Belton electric line to Greenville and Spartanburg, was chartered on March 10, with W. J. Thackson, of Greenville, as president and treasurer; J. R. Vandiver and T. F. Mill, both of Anderson, S. C., as vice-president and secretary, respectively. The papers show that J. B. Duke, R. N. Duke and Geo. W. Watts, all of New York, have subscribed for $110,000 of the stock, J. B. Duke for $70,000 and the other two for $20,000 each. B.

FITZGERALD, GA.—The city council renewed the franchise of Fitzgerald & Ocilla Electric Railroad, and it is announced that the road will now be built, contract having been awarded to American Construction Co., 90 West street, New York. The engineer representing the construction company is already on the scene. It is reported that the company has purchased a tract of 450 acres between Fitzgerald and Ocilla, and will develop it into a park. A lake on the property will also be beautified. It is reported that S. Tilden Holtzendorf, 61 Fifth Avenue, New York, and associates are promoting the construction of this road. B.

AKRON, O.—Manager Charles Currie, of the Northern Ohio Traction and Light Company, has announced that his company has employed Cleveland agents to complete the purchase of a private right of way between Cleveland and Akron which will give the Akron, Bedford & Cleveland line a shorter route to Cleveland. The chief object back of this move is to give the railroad an opportunity to handle freight, its franchises over highways preventing them from engaging in this kind of business. Currie declares it is a part of a plan of all Cleveland interurban companies to build an elevated railway from the Cleveland city limits to the Public Square, and a freight and passenger station to handle the business of the combined roads.

DOYLESTOWN, PA.—The board of directors of the Lehigh Valley Transit Company in Allentown, has arranged for a meeting of stockholders on April 21 to approve a proposed increase of indebtedness from $9,000,000 to $15,000,000. The meeting will be a legal formality, as officers who favor the increase own a large majority of the stock. The money will be used to refund the improvement bonds, defray consolidated mortgage bonds and provide for improvements and extensions. The company now has 200 miles of tracks from Philadelphia north, to Statington and from Nazareth on the east to Macungie on the west. The money for improvements will go largely into new construction in the way of eliminating curves, building stronger bridges, securing new rolling stock and bringing about general development. The system is owned chiefly by E. B. Smith and Company, and Brown Brothers and Company, of Philadelphia.

GREENVILLE, TEXAS—The Eastern Texas Traction Company has just been organized and a charter granted it by the secretary of state. Its purpose is to build an extensive system of interurban electric railways in this part of Texas. These lines will radiate from Greenville where the principal offices of the company are situated. It is stipulated in the charter that the system shall extend from Greenville to the towns of Wolfe City, Bonham, Denison, Honey Grove, Paris, Cooper, Clarksville, Dallas, Plano, Chisholm and Forney. The incorporators are J. B. Murphy J. H. Blocker, H. E. Vaughan, W. M. McBride, H. C. Tittsworth, Glen A. Coulson, J. Riley Green, S. B. Perkins, J. H. Myrick, R. N. White, L. N. Byrd and Joseph F. Nichols. It is stated by the promoters of the project that good progress is being made in the preliminary arrangements for the construction of the proposed system. It is expected that active construction work will be started this spring, and the different lines built rapidly. More than 250 miles are involved in the different lines embraced in the system. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence)

SILVER CREEK, NEB.—The Silver Creek Telephone Company will build a telephone office. C.

CHETEK, WIS.—The Chetek Telephone Company has been incorporated with a capital of $5,000. P.

TISCH MILLS, WIS.—The County Line Telephone Company has been incorporated with a capital of $5,000. P.

LITCHFIELD, NEB.—The Farmers Mutual Telephone Company has been incorporated with a capital of $20,000 P.

EXCELSIOR, MINN.—The Tri-State Telephone Company is considering the installation of an exchange here. C.

DESMET, S. D.—The Badger Mutual Telephone Company has been incorporated with a capital stock of $20,000. P.

CASCADE, MONT.—The Great Falls Automatic Telephone Company has arranged for the installation of an exchange. C.

SAN DIEGO, TEXAS.—The S. G. Smith Telegraph and Telephone Company has completed the installation of its local exchange here. D.

MARYLAND, ARK.—The Farmers Telephone Company has been incorporated with a capital stock of $12,000. H. M. Crockett is president. P.

DAYTON, N. M.—The Dayton telephone system has been sold by Messrs. VanEpps and Jorns to J. Bishop. It will be enlarged and improved. D.

ASHERTON, TEXAS.—The Asherton Telephone Exchange is the name of a new company that has established a telephone system here. It already has a liberal patronage. D.

SUPERIOR, WIS.—The Tri-State Telephone Company has gained control of the People's Telephone Company of Superior and the Zenith Telephone Company of Duluth. The consolidation of the systems will be started soon. M.

WINNIPEG, CANADA.—The question has arisen again in the Carlyle, Man., and surrounding district to establish a rural telephone system, and there is every reason to believe that action in regard to same is to be taken in the near future. R.

PACHUCA, STATE OF HIDALGO, MEXICO.—The Compania Nacional de Telefonos has finished the construction of its new line to the city of Tulancingo. It has established a local exchange of about one hundred telephones in Tulancingo and is adding to the number constantly. D.

TOLEDO, OHIO.—The property of the Home Telephone Company at Paducah, Ky., was recently sold for $50,000. It was valued at $250,000 and was bid in by the Central Home Security Company, of Toledo, holders of the bonds. It will be added to the holdings of the Central Home Telephone Company, of which E. L. Barber is the head. H.

BELLEVUE, OHIO.—Linemen have been busily engaged recently in making the necessary change to transfer the long-distance wires of the Bell company from its present station into the exchange of the Bellevue Home Telephone Company. Under the present arrangement patrons of the latter company will be able to secure connections with foreign subscribers to the lines of the Bell Telephone Company. H.

WINNIPEG, CAN.—S. P. Porter, deputy minister of the railways and telephones, while in Moose Jaw, Sask., announced that the department would spend $125,000 in the city this year. A completely new telephone system would be installed and a handsome exchange system be erected, a site for which has already been purchased. The department has also decided to complete a long distance line to Outlook this year, a distance of 125 miles, and possibly one from Moose Jaw to Swift Current. R.

PULASKI, WIS.—Two new telephone companies have been organized here. The Pulaski Merchants' and Farmers' Telephone Company, with a capital stock of $5,000, has been organized to construct an exchange for the surrounding villages and farm houses. The incorporators are: J. A. Peplinski, F. K. Peplinski, and J. Trompczynski. The Avoca and Pride Hollow Telephone Company has also been organized here with a capital stock of $300. The incorporators are John Steinhart, Edwin Schunk, and Andrew Hanson. M.

OAXACA, MEXICO.—An extensive system of government telephone lines is being constructed in the state of Oaxaca In this district alone more than 300 miles of new long-distance lines have been built during the last year, connecting this city with a number of towns, and these places in turn being connected with the telephone lines that extend to other parts of the state. The large mileage of lines constructed in this district is due chiefly to the activity of the local jefe politico, Salvador Bolanos Cacho. The establishment of telephone communication with the various towns and villages of the state is already producing splendid results, it is claimed, in the matter of suppressing lawlessness and in aiding in the transaction of business. D.

SALT LAKE CITY, UTAH.—Telephone connection to the extreme eastern portion of Montana was established when a new line built by the Montana Eastern Telephone Company was connected with the Rocky Mountain Bell Telephone exchange at Billings. The new territory added to the Bell system by the completion of this line includes all the Yellowstone valley east of Billings, with tributary lines reaching the more important communities distant from the river. The principal towns that have long distance service as a result are Huntley, Custer, Forsyth, Rosebud, Miles City, Terry and Glendive. The Montana Eastern Telephone Company has connections eastward to the Twin Cities. A test conversation was established successfully between Miles City, Mont., and Salt Lake, a distance of 880 miles.

AUSTIN, TEXAS.—The case of the South Texas Telephone Company vs. H. E. Huntington et. al., which was appealed to the supreme court on application for writ of error, must be tried again in the lower court. The supreme court has dismissed the application for want of jurisdiction. The South Texas Telephone Company owns independent long-distance telephone lines extending from Waco to San Antonio, Austin, Galveston, Orange, Houston and a number of other towns in the state. H. E. Huntington, of Los Angeles, Cal., and F. C. Smith, of San Antonio, obtained judgment against the company in the lower court in the sum of $46,666 for the cancellation of $35,000 of bonds, and decreeing a lien on what is known as the property of the old Lone Star Telephone Company. A remittitur of $3,500 was afterwards filed, reducing the judgment to $43,166. The case was appealed to the court of civil appeals, which tribunal ordered it reversed and remanded. The company then applied to the supreme court for a writ of error, with the result above stated. D.

ELECTRICAL SECURITIES.

Last week's money and stock markets were unsettled by a number of disturbing factors, principal of which were the tightening money markets and the threats of labor troubles. The rise in money rates has its special importance for the New York market at this time owing to the large number of new bond issues coming on the market. Subscriptions for the bonds already issued have their plan in causing the rise in money rates. There has been an almost general drop in value of electrical securities.

At the annual meeting of the Western Telephone Company the directors were re-elected. There were 250,000 shares voted out of a total of 320,000.

The entire $3,000,000 Southern Power Company first mortgage 5s offered by N. W. Harris & Company and the National City Bank have been sold.

The Kansas City and St. Louis Electric Railroad has placed $15,000,000 thirty-year five-per cent mortgage bonds in London.

Vacancies in the board of the Electric Boat Company have been filled by the election of Stacy C. Richmond, James F. D. Lanier and Henry R. Carse.

At the annual meeting of the Manila Electric Railway and Light Company J. H. Pardee was elected a director to succeed R. B. Marchant, retired. Other directors were re-elected.

The Boston and Worcester Street Railway Company has sold the $350,000 twenty-year four-and-one-half-per cent bonds, authorized by the Massachusetts Railroad Commission, to N. W. Harris & Company.

The annual meeting of the stockholders of the General Electric Company will be held at the company's office in Schenectady, N. Y., May 10, to elect directors for the ensuing year. Books will be closed April 9 and reopen May 11.

The Berkshire Street Railway Company has petitioned the Massachusetts Railroad Commission for approval of terms of purchase of the Pittsfield Electric Street Railway Company, which provides for an increase in stock of the Berkshire Street Railway by $300,000, par $100, to be exchanged for Pittsfield Company stock.

N. W. Harris & Company have sold $1,244,000 Rochester Railway and Light Company consolidated mortgage 5s, and $693,000 Scranton Electric Company first and refunding mortgage 5s.

The Harris Trust Company and E. H. Rollin & Sons have purchased $1,750,000 first mortgage five per cent bonds of the Joplin and Pittsburg Railway, which operates one hundred miles of electric street railway and interurban lines, serving the cities of Joplin, Mo., Girard, Columbus and Pittsburg, Kan., and adjacent points.

The New York Public Service Commission, Second District, has authorized the Niagara Light, Heat and Power Company of Tonawanda, to issue $21,000 of an issue of $500,000 bonds, at not less than eighty-five. The Commission has also authorized the Cliff Electrical Distributing Company of Niagara Falls to issue $400,000 five-per cent thirty-year bonds at not less than ninety-five.

Directors Earling, Fair and Felton, of the Chicago City Railway, have resigned and been succeeded by Honore Palmer, E. R. Bliss and B. E. Sunny. Mr. Bliss is counsel for the company. Mr. Fair represented the Marshall Field estate. Officers have been re-elected. The gross earnings for the past two weeks in March gained over eleven per cent, as compared with the corresponding period of 1909. The management says that with enough new cars the increase would have been fifteen per cent.

The stockholders of the Mahoning and Shenango Valley Railway and Light Company will, on May 16, vote on a stock increase from $10,000,000 to $11,000,000, the added million to be preferred stock. At the present time half of the company's $10,000,000 stock is preferred, and the other half common. The company contemplates making extensive improvements on its various lines.

A special stockholders' meeting of the North Shore Electric Company will be held April 20 to increase the capital stock from $5,000,000 to $7,000,000 and approve a $25,000,000 thirty-year five-per cent first and refunding bond issue, of which $500,000 has been sold to N. W. Halsey & Company and Russell, Brewster & Company. The stockholders are to be offered subscription rights on $1,000,000 of the new stock on the basis of ten per cent of their holdings.

Stockholders of the Brooklyn City Railroad have been informed by their president that, notwithstanding the recent judgment which the Brooklyn Rapid Transit Company obtained against their company the Brooklyn City would continue to pay dividends at the regular rate until its appeal from the referee's decision has been decided either for or against it.

DIVIDENDS

Detroit Edison Company; regular quarterly dividend of one per cent, payable April to stock of record April 4.

Duluth-Superior Traction Company; regular quarterly dividend of one per cent on preferred stock, payable April 1, to stock of record March 19.

Electrical Securities Corporation; regular semiannual dividend of two and one-half per cent on the preferred stock, payable May 1, to stock of record April 30, and the regular quarterly dividend of two per cent on the common, payable April 1, to stock of record March 31.

Germantown Passenger Railway; quarterly dividends of $1.31¼, payable April 5.

Massachusetts Lighting Company; regular quarterly dividend of one and one-half per cent, payable April 15 to stock of record March 30.

North Shore Electric Company; quarterly dividend of one per cent, an increase of one-quarter of one per cent, payable May 1 to stock of record April 20.

Tri-City Railway and Light Company; regular quarterly dividend of one and one-half per cent on the preferred stock, payable April 1 to stock of record March 21.

NEW YORK.

	Mch. 21	Mch. 14
Allis-Chalmers common	11¾	12
Allis-Chalmers preferred	42⅜	42
Amalgamated Copper	78⅛	78¾
American Tel. & Cable	*80	*80
American Tel. & Tel.	141⅛	141¾
Brooklyn Rapid Transit	75½	76½
General Electric	154½	154
Interborough-Metropolitan common	21⅜	22⅛
Interborough-Metropolitan preferred	56	56⅜
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	89	89¼
Mackay Companies (Postal Telegraph and Cables) preferred	76	76⅞
Manhattan Elevated	135¼	138½
Metropolitan Street Railway	15	15
New York New Jersey Telephone	122	123½
U. S. Steel common	85¼	88¼
U. S. Steel preferred	121⅛	122
Western Union	75	75½
Westinghouse common	70	73
Westinghouse preferred	130	130

*Last price quoted.

BOSTON.

	Mch. 21	Mch. 14
American Tel. & Tel.	141⅛	141¼
Edison Elec. Illuminating	255	249
General Electric	154½	154
Massachusetts Electric common	17½	18
Massachusetts Electric preferred	83	84
New England Telephone	137	138
Western Tel. & Tel. Common	16	16
Western Tel. & Tel. preferred	88	88

PHILADELPHIA.

	Mch. 21	Mch. 14
American Railways	45¼	45½
Electric Company of America	12	12
Electric Storage Battery common	63	64
Electric Storage Battery preferred	63	64
Philadelphia Electric	16⅛	15⅛
Philadelphia Rapid Transit	22½	21
Philadelphia Traction	87	85¾
Union Traction	49½	48¾

CHICAGO.

	Mch. 21	Mch. 14
Chicago Railways, Series 1	104	104
Chicago Railways, Series 2	31	32
Chicago Subway	3	3
Chicago Telephone	134	132
Commonwealth Edison	116½	116
Metropolitan Elevated common	16	16
Metropolitan Elevated preferred	52	53
National Carbon common	113	110
National Carbon preferred	120	119

PERSONAL MENTION.

C. A. COFFIN, president of the General Electric Company, left last week for a month's sojourn in California.

GEO. T. BLACKMAN, of Sioux Falls, S. D. has been elected president of the Sioux Falls Light and Power Company.

DR. LOUIS T. MORE, professor of physics, has been elected dean of the College of Liberal Arts of the University of Cincinnati.

JOHN B. MILLER, president of the Southern California Edison Electric Company, sailed last week on the Celtic for an automobile tour of Europe.

JOHN S. SHEARER, professor of the department of physics of Cornell University, is acting as a member of the Columbia University faculty during the rest of the present college year. Professor Wm. H. Hallock, head of the department of physics of Columbia University, will spend the period in Europe.

W. S. HEGER, Los Angeles manager for the Allis-Chalmers Company, has accepted the position of manager of the company's San Francisco office in place of R. B. Elder, resigned. Mr. Heger was formerly located in San Francisco as manager of the Westinghouse Electric and Manufacturing Company. After holding that position for ten years he resigned to become associated with the Allis-Chalmers Company.

L. H. CONKLIN, recently general manager of the Scranton Electric Company of Scranton, Pa., has been engaged as an engineer in the operating department of J. G. White and Company of New York. Since Mr. Conklin's graduation from Pratt Institute in 1891 he has been connected with several operating and engineering companies. He is a member of the American Institute of Electrical Engineers, past president of the Pennsylvania Electric Association and ex-officio member of the executive committee of the National Electric Light Association.

OBITUARY.

PHILIP E. ELIVIER, superintendent of the electrical department of the Superior Water, Light and Power Company, died at his residence, 1506 Belknap street, Superior, Wis., after suffering for several months with cancer.

RICHARD P. ROGERS, sixty-seven years old, who was connected with the John A. Roebling's Sons Company for forty years, died on March 13. He was the oldest employe of the company, and besides acting for many years as special factotum for the late Henry L. Shippy, of the Roebling company, kept the petty cash, time records, and acted as bank messenger. He was a colored man of courtly manners, and possessed to a high degree the faculty of remembering faces and names. He was greatly respected by all who knew him. The recent death of his greatly beloved superior, Mr. Shippy, is believed to have hastened his end.

GARDINER C. SIMS, president of the William A. Harris Steam Engine Company of Providence, R. I., died March 19 of Bright's disease at his home in Providence. Starting work as a boy in the locomotive shops of the New York Central & Hudson River Railroad Company at West Albany, N. Y., Mr. Sims rose to the position of superintendent of the J. C. Hoadley Engine Works at Lawrence, Mass. Later he became chairman of the committee on electricity at the World's Columbian Exposition. During the Spanish-American war he did notable work in connection with the engineering department of the navy. At the termination of the war he assumed the position of superintending engineer of the United States Army Transport Service.

LEGAL NOTES.

CANNOT COLLECT EXCESS FARE.—The Railroad Commission of Indiana has refused to authorize the Muncie & Portland Traction Company to charge an excess fare when passengers who board cars at stations neglect to purchase tickets. The company complains that it has recently been annoyed by passengers tendering bills of large denomination in payment of fare on the cars. The attorney general of Indiana recently expressed the opinion to the Railroad Commission that the cash fare and the ticket fare on an interurban railway must be the same. The railroad commission says that proffer of what constitutes a legal tender in the matter of paying legal fare is a question for the courts to decide. It is further decided that the law applying to steam roads does not hold for electric lines.

CUSTOMER CAN NOT BREAK ONE CONTRACT TO MAKE ANOTHER.—In an action by the Indianapolis Light and Heat Company against the Columbia School Supply Company, Judge Carter of the Superior Court held that a clause in a contract providing that the school supply company should have the benefit of any reduction in the contract price of four and one-half cents per kilowatt hour for this class of service, but could not throw up its contract with the Indianapolis Light and Heat Company and contract with another company. This decision is regarded important and will enable one company to enjoin its patrons from throwing up contracts to contract with another company as long as the company is ready to furnish at the usual price for this class of service. S.

OVERPAYMENTS FOR ELECTRICITY RECOVERABLE.—A contract for electricity provided that payment therefor should be "the sum of $20 per horsepower per year of 365 days of twelve hours each, and at the same rate for each and every hour per day in excess of said twelve hours." During a considerable period the power was measured by the purchaser's electrician, and the price to be paid was computed by him in conjunction with the furnisher. The computations were made at the rate of $20 per horsepower for 340 days of ten hours each, which a new electrician contended was wrong, but which was sought to be justified in consequence of the fact that during certain portions of the day when the receiver's employees were at their meals the minimum of 350 horsepower was

not taken, the contentions being that because such minimum power was not received during twelve consecutive hours, but only ten out of twelve, or twenty out of twenty-four hours, and because one day in a week there was no obligation to furnish power for more than twelve hours, the rate of compensation should be as computed. The third appellate division of the supreme court of New York, however, holds that this is wrong; also holds, Payne vs. Witherbee, Sherman and Company, 117 N. Y. S., 15, that there was no reason in law or justice why the overpayments on that basis should not be recovered, having been made by mistake, consisting in ignorance of the fact that the computations were not being made according to the rule declared in the contract, which was excused on account of its being a matter requiring technical knowledge to verify. Moreover, while the computations were made by the receiver's own electrician, he was not authorized to deviate from the written contract as to the basis of such computations, while his unauthorized act was never assented to or ratified, but repudiated as soon as ascertained.

PROPOSALS.

POST OFFICE, CONCORD, N. C.—The office of the Supervising Architect, Washington, D. C., will receive bids until April 19 for the construction (including plumbing, heating apparatus, electric conduits and wiring) of the United States Post Office at Concord, N. C., in accordance with drawings and specification, copies of which may be had from the custodian of site at Concord, N. C., or at the Supervising Architect's office.

POST OFFICE, KANSAS CITY, KAN.—The office of the Supervising Architect, Washington, D. C., will receive bids until April 25 for the extension, etc., except elevator (including plumbing gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Kansas City, Kans., in strict accordance with drawings and specification, copies of which may be obtained from the custodian at Kansas City, Kan., or at the Supervising Architect's office.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers dsired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date.	Material.	Quantity.	Delivery at navy yard.	Sch. No.
April 5—	Condulets	Miscellaneous	Norfolk, Va.	2344
	Cord, silk covered	2,667 yards	Norfolk, Va.	2344
	Fans	3	Norfolk, Va.	2338
	Globes, lamp	836	Norfolk, Va.	2344
	Motors	4	Norfolk, Va.	2344
	Motor, switchboard, and wire	Miscellaneous	Brooklyn, N. Y.	2337
	Supplies, electrical	Miscellaneous	Norfolk, Va.	2344
	Wire, rubber covered	16,900 feet	Norfolk, Va.	2344

NEW PUBLICATIONS.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY—The fifth catalogue of this institution is being distributed and contains a complete record of all students of the class of 1893. In addition to this it contains several new features and information of considerable interest to the educational world.

HISTORY AND DESCRIPTION OF RAPID TRANSIT ROUTES IN NEW YORK CITY—Under this title the Public Service Commission for the First District, State of New York, describes in detail the various transit lines constructed, together with a map for each route, and a combination map showing the routes of all rapid transit lines in greater New York.

THE UNIVERSITY OF MINNESOTA BULLETIN—The College of Engineering and Mechanical Arts of the University of Minnesota is distributing bulletin No. 7, which contains a description of the schools, colleges and departments of the University, the names of the faculty, the entrance requirements and examinations, and a vast amount of other general information, including descriptions of the buildings and equipment of the various laboratories, courses of studies, etc.

JOHN HOPKINS UNIVERSITY CIRCULAR—This publication embodies a number of important results obtained in the physical laboratory of this institution, among which may be named the following subjects: The dielectric strength of air, the reactance of iron conduit for two conductors, the resistance and reactance of armored cables, and standard wave length of iron lines. In addition to this matter the circular contains a list of the recent publications in physics and a review of the proceedings of various engineering societies.

THE CLARKSON BULLETIN—This bulletin, issued by the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. J., contains several features of more than passing interest. Among the interesting articles is one descriptive of the turbine water wheel as a prime mover and also the Founder's Day address by Ira N. Hollis on Training Men for the Industries and the Advancement of Science. In addition this issue contains a large amount of informtaion concerning meetings, courses of study, requirements for admission, etc.

INDUSTRIAL ITEMS.

THE EXCEL ELECTRIC HEATING COMPANY announces that its office has been moved from 54 Vesey street, New York city, to 52 Lawrence street, Newark, N. J.

W. N. MATTHEWS & BROTHER, St. Louis, Mo., has mailed an interesting postal card describing how cables may be strung in the best way by the use of Matthews cable rollers.

GEORGE BATTEN COMPANY announce tnat on March 18 they moved from their quarters at 11 East Twenty-fourth street, to new and larger quarters at Fourth avenue and Twenty-seventh street, New York city.

THE RICHARDSON ENGINEERING COMPANY, Hartford, Conn., has just got out a booklet describing its gasoline-engine generating-sets and storage-battery auxiliaries designed for small isolated plant service.

THE ELECTRICAL TESTING LABORATORIES, New York city, tell, in their recent booklet, "Power from Coal," some of the things that must be considered when coal is purchased. The company is prepared to conduct tests on coal.

THE METROPOLITAN SWITCHBOARD COMPANY, Long Island, N. Y., will soon move into its new building at East avenue and Fourteenth street, near the Fifty-ninth street bridge. The exact date of removal will be given later.

THE NATIONAL-ACME MANUFACTURING COMPANY, Cleveland, Ohio, has shown in its recent booklet "Little Things and Big" that it is prepared to furnish the machinery that will do small manufacturing operations quickly, accurately, and economically.

THE BRILLIANT ELECTRIC COMPANY, Cleveland, Ohio, has distributed a folder answering the question, "Where Is Brilliant Mazda?" The folder contains a list of the twenty-seven agents carrying these lamps in stock. The agents are scattered through sixteen states.

THE S. M. HILDRETH COMPANY, New York, N. Y., has placed on the market a collapsible horse or trestle which is very convenient for use where light construction work is being done. The trestle is made of angle iron, and may be folded to occupy a very small space.

H. E. WALKER LUMBER COMPANY, Minneapolis, Minn., gives interesting testimony relative to the life of white cedar, in a recent folder. A post shown in the illustration was carved with a date more than fifty years ago. In spite of its long exposure the post is still sound.

THE COLUMBUS BUGGY COMPANY, Columbus, Ohio, is sending out an attractive booklet relative to their electric automobiles. The pamphlet, entitled "For Her," draws especial attention to the suitability of these electrics to the American woman, who desires speed, ease and luxury.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has received the contract for supplying power equipment to the Ford Plate Glass Company, of Toledo, Ohio. The turbo equipment will consist of a 2,500-kilowatt, forty-cycle, three-phase, 580-volt alternator direct-coupled to an Allis-Chalmers turbine.

PERLEY LOWE AND COMPANY, 1603 Railway Exchange, Chicago, Ill., announce that they make a specialty of poles twenty-five feet and under for telephone lines and extension work. These poles which are guaranteed to be sound and straight are well selected and can be economically handled from the company's large yards at Peshtigo, Wis.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, California, has issued the February number of its monthly bulletin, "Hot Points." This issue is largely devoted to the Model "G" which is described as being, not a new iron but the old "tried and trusty" in a new dress. A reproduction of the diploma awarded the Hot Point is shown.

THE PETTINGELL-ANDREWS COMPANY, has in its March issue of "Juice," a number of particularly interesting articles. Among others is an account of the development of Opalux reflectors and a digest of several recent central station experiments with light efficiency lamp service. The company has recently adopted a very artistic monogram letter-head, which is shown in this number of "Juice."

STANLEY G. FLAGG & COMPANY, Stowe, Pa., will equip its new factory with a 300-horsepower producer plant driving a 175-kilowatt direct-curent generator. The engine is of the horizontal, double-acting, Westinghouse producer-gas type, and develops 300 horsepower by brake test. The engine is direct connected to a 175-kilowatt direct-current generator, furnishing 110-volt current for lighting and power in the new factory.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, of Pittsburg, Pa., is sending to central stations, No. 13 of its series of advertising booklets.The advertisements in this publication deal with the subject of moving day. The importance of moving into a house wired for electric lights is dealt with from many sides, and in such a way as to appeal to tenants who have not been satisfied with gas lighting. The advantages of the electrically driven shop are also touched upon. The booklets are

sent out as suggestions to central stations who are looking for live advertising matter.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, Ohio, is using a folder entitled, "Another Record." The record is one made with rail handling magnets, at Gary, Ind., where, as a reproduction of a telegram shows, a car of light rails was loaded in five minutes. The February number of this company's publication, "Common Sense," contains a continuation of the article on dynamic braking.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., recently received an order from the Ray Consolidated Copper Company for four horizontal twin tandem, triple expansion heavy duty engines for its plant at Hayden Junction, Ariz. These will have cylinders twenty-eight, fifty-two, fifty-four and fifty-four by forty-eight inches. The engines will each be connected to an Allis-Chalmers 2,200-kilowatt, three-phase, sixty-cycle, 6,600-volt alternator.

THE TOWER BINFORD ELECTRIC AND MANUFACTURING COMPANY, Richmond, Va., has published its new catalogue No. 6 of electrical supplies and apparatus. The catalogue contains prices of a very complete line of electrical material. The company expects to be in its new quarters at No. 5 Governor street by April 1. In its new location it will have about 30,000 square feet of floor space in which to conduct its electrical jobbing business.

THE INTERNATIONAL STEEL TIE COMPANY, a Pennsylvania corporation, capitalized at $2,000,000 has decided to establish a branch plant in Chicago, to take care of its western business. The exact location will be decided at an early date and work will begin on the buildings next month. The company manufactures steel railroad ties. Its plant here will cover over an acre of ground and will represent an investment of over $200,000. The steel tie industry is new but the project is meeting with success. A demonstration of the merits of the ties will be given in Chicago on a section of the local roads.

THE DEUTSCHE BECK-BOGENLAMPEN-GESELLSCHAFT, of Frankfort on the Maine, Germany, has taken over the business of the Carbone-Licht-Gesellschaft, of Berlin-Weissensee, Germany, the latter concern having gone into liquidation. The Beck Company will continue the manufacture of the various types of Carbone lamps at the Berlin factory of the old Carbone Company which will be known as its "Carbonlicht" department and will be maintained in full operating condition for this purpose. The various types of Beck lamps will be manufactured at Frankfort as heretofore, and will be distributed from both the Berlin and Frankfort branches of the company.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has just issued a bulletin, No. 5,111, descriptive of its new design of "Hawthorn," Type "LL," multipolar, engine driven, direct current generators. A full description of all of the details of design and construction is given and the merits of the parts are pointed out. In addition to the regular two-wire generators, there are described and discussed type "LL" three-wire generators and balancer sets for use with either of two systems for the maintenance of a three-wire system of distribution with balanced voltage.

THE SOUTHERN COTTON OIL COMPANY, Montgomery, Ala., is planning after three years of operation with gas power apparatus, to install about 1000 horsepower of like equipment each year. In accordance with this policy, the company has just put into service at its Montgomery, Ala., plant two Westinghouse bituminous gas producers and two gas engine sets, having a total capacity of about a thousand horsepower. The producer plants are of the T-50 type, recently marketed by the Westinghouse Machine Company, East Pittsburg, Pa. The gas engines are belted to the line shaft, operating the machines of the mill through the medium of shaft, pulleys and belts. The new gas engine equipment is auxiliary to several steam engines which have previously been used to supply power for the mill.

THE UNION SWITCH AND SIGNAL COMPANY, Pittsburg, Pa., recently held its annual meeting, at which Geo. Westinghouse, president, commented on the favorable business conditions. Mr. Westinghouse stated that, while the company's statement of last year's business did not show a very large profit, since the beginning of this year, business had considerably improved; in fact, the earnings for January alone exceeding the amount of the first quarter's dividend. He said: "The wisdom of building an addition to your factory is now proving itself of great benefit, the works, with their present facilities, can take care of fifty per cent more business than the company has ever done during the most prosperous period of its history." At the annual meeting John P. Miller, vice-president of the Westinghouse Air Brake Company, was elected a director, to succeed the late Robert Pitcairn. Other directors were re-elected.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has recently issued a new and attractive booklet, showing a complete line of lighting fixtures known as Hawthorn Mazdaliers. The anti-jar link suspension, a protective device which adds to the life of the tungsten filament by eliminating all vibration and jar, is shown in detail. The booklet is well illustrated and shows the construction of the different parts of the Mazdaliers, while the descriptive matter gives detailed information regarding those parts as well as features of installation. "How to Figure Illumination," is the title of an attractive bulletin which is being circulated by the same company. It treats in a thorough and comprehensive manner the lighting of interiors and gives useful information in connection with Sunbeam Mazda lamps. Anyone without even an elementary knowledge of illuminating engineering can easily figure the illumination required for any space by use of the tables and data given.

DATES AHEAD.

Minnesota Electric Association. Annual convention, Minneapolis, Minn., March 29, 30 and 31.

Minneapolis Electric Show, Minneapolis, Minn., March 26, April 2.

Missouri Electric, Gas, Street Railway and Water Works Association. Next convention, Jefferson City, Mo., April 14, 15 and 16.

Florida Electric Light and Power Association. Next meeting, Tampa, Fla., April 21.

Iowa Electric Association and Iowa Street and Interurban Railway Association. Annual conventions, Sioux City, Ia., April 21, 22 and 23.

National Electric Light Association. Annual convention, St. Louis, Mo., May 23-28.

Michigan Electric Association. Annual convention, Port Huron, Mich., August 16, 17 and 18.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired March 21, 1910:

493,672. AUTOMATIC ELECTRIC CUT-OUT. Francis B. Badt, Chicago, Ill.

493,673. SYSTEM FOR TRANSMITTING ELECTRIC CURRENTS. Edward Baines, Brooklyn, N. Y.

493,678. ELECTRIC RAILWAY-SIGNAL. Jefferson Bradford and James P. Williams, Boston Station, Ky.

493,679. DYNAMO-ELECTRIC MACHINE AND MOTOR. Harold P. Brown, New York, N. Y.

493,692. STEERING APPARATUS. Thomas Ellis, Rochester, Mass.

493,704. LISTENING AND RINGING KEY FOR TELEPHONE SWITCHBOARDS. William M. Goodridge, Highland Park, Ill.

493,716. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS. Elias Hazelton, Lansing, Mich.

493,718. DYNAMO-ELECTRIC MACHINE. Santa Hellebrandt, Przemsyl, Austria-Hungary.

493,739. ELECTRIC-ARC LAMP. Elihu Thomson, Lynn, Mass.

493,745. DYNAMO-ELECTRIC MACHINE. Foree Bain, Chicago, Ill.

493,754. ELECTRIC CONNECTOR AND CUT-OUT. Charles H. Crockett and Chancellor C. Allen, Boston, Mass.

493,755. ELECTRIC CUT-OUT. Charles H. Crockett and Chancellor C. Allen, Boston, Mass.

493,777. ELECTRIC CLOCK STRIKING MECHANISM. William Kaisling, Allegheny, Pa.

493,842. ELECTRIC-LIGHTING SYSTEM. Samuel W. Rushmore, Brooklyn, N. Y.

493,868. SWITCH FOR ELECTRIC-LIGHT FIXTURES. Joseph Hutchinson, New York, N. Y.

493,907. TELEPHONE. Charles T. Bloomer, New York, N. Y.

493,918. ELECTRICALLY-OPERATED RAILWAY-SWITCH. Powell Evans, Philadelphia, Pa.

493,935. ELECTRIC RAILWAY-SIGNAL. Henry V. Miller, Bloomington, and Alexander C. Miller, Aurora, Ill.

493,942 and 493,943. ELECTRIC LOCOMOTIVE. Alexander Philipsborn, Berlin, Germany.

493,948. CLOSED CONDUIT FOR ELECTRIC RAILWAYS. George W. Von Siemens, Berlin, Germany.

493,969. ELECTRIC CAR. Charles Brown, Basle, Switzerland.

493,997. ELECTRICAL ATTACHMENT FOR ROCKING-CHAIRS. Charles E. Hartelius, Bay Ridge, N. Y.

494,042. SYSTEM OF WINDING ARMATURES FOR DYNAMO-ELECTRIC MACHINES. William M. Thomas, Grand Rapids, Mich.

494,053. RECIPROCATING ELECTRIC DRILL. William A. G. Birkin, Nottingham, England.

494,062. SECONDARY-BATTERY ELECTRODE. William W. Donaldson and Roderick Macrae, Baltimore, Md.

494,077. RAILWAY BLOCK-SIGNAL. Robert D. Peters, Winamac, Ind.

494,091. ELECTRIC CIGAR-LIGHTER. William M. Thomas, Chicago, Ill.

494,098. ELECTRICAL APPLIANCE. Charles H. Folger, Cincinnati, Ohio.

494,111. ELECTRICAL RAILWAY-SIGNAL. Samuel W. Miller and Alexander C. Miller, Aurora, and Henry V. Miller, Bloomington, Ill.